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ANNALS

OF THE

MISSOURI BOTANICAL GARDEN

ERRATA

Page 4, line 26—for "35. COELIA" substitute "35. BOTHRIOCHILUS"; line 28 —for "column" read "pollinia."

Page 145, caption of fig. 2, second line—for "var. *ioense*" read "var. *ioensis.*"

Page 146, Explanation of Plate 1—for "var. *ioense*" read "var. *ioensis.*"

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Missouri Botanical Garden

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of the
Missouri Botanical Garden

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FLORA OF PANAMA

BY

ROBERT E. WOODSON, JR.

AND

ROBERT W. SCHERY

AND COLLABORATORS

PART III

Fascicle 2

ORCHIDACEAE (Williams)
(in part)

ANNALS
OF THE
MISSOURI BOTANICAL GARDEN

Vol. XXXIII FEBRUARY, 1946 No. 1

FLORA OF PANAMA

Part III. Fascicle 2

ORCHIDACEAE

By LOUIS O. WILLIAMS

Epiphytic, terrestrial, rarely semi-aquatic or saprophytic, perennial herbs. Vegetative growth of two main types: (1) Termed MONOPODIALES, in which the main axis or stem grows steadily upward year after year, the annual growths at length being indistinguishable and a monopodium being formed; the inflorescences borne on lateral shoots. (2) Termed SYMPODIALES, in which a new growth develops laterally from the base of the previous year's growth, which is completed and matures in a few months. In the SYMPODIALES if the annual growth is terminated by an inflorescence the plant is termed *acranthous* (terminal flowering); if the inflorescence originates on lateral branches (usually at the base of or laterally on a pseudobulb) and the annual growth is terminated only by leaves the plant is termed *pleuranthous* (lateral flowering). Stems (secondary) of many orchids developed into thickened or swollen structures (pseudobulbs) which act as storage organs for food and moisture. Flowers hermaphroditic and gynandrous, occasionally monogamous or polygamous, the male and female ones being very different; zygomorphic; superior. Perianth of two tripartite whorls, alternating, often variously united; in the same whorl the even pair similar, the odd one usually different in form. Sepals 3, similar, or the dorsal differing from the laterals, free or variously united. Petals 3, two similar and termed petals, the other one usually strikingly different and termed lip or labellum. Stamens in two tripartite whorls, only one (MONANDRAE) or two (DIANDRAE) fertile, the others, along with the styles and sterile stigmas, forming the column by consolidation; in the MONANDRAE the odd stamen of the outer whorl fertile; in the DIANDRAE the paired stamens of the inner whorl fertile. Pollen (except in the CYPRIPEDILOIDEAE) usually consolidated into pollinia. Stigmas 3, usually only one or two fertile (if two, often confluent and appearing as one). The column, the central structure in the flowers, which is made up of the consolidated styles and filaments along with the suppressed anthers and stigmas, is diagnostic of the family. Fertile anthers and stigmas usually borne toward the apex of the column. Ovary 1-celled or rarely 3-celled. Seeds numerous, minute, lacking endosperm.

Issued March 8, 1946.

A cosmopolitan family of about 600 genera and 15,000–20,000 species. Most abundant in tropical regions of the world.

The Orchidaceae is an extremely complex family, the morphology of which is often not too well understood. The genera, in some groups, are technical and perhaps not too well differentiated; in other groups they are fairly well differentiated. With the exception of a few terrestrial genera and even fewer of the epiphytic ones, the respective genera are limited to either the eastern or to the western hemisphere. A few genera contain a very large number of species (*Dendrobium*, eastern hemisphere, probably more than 1000; *Epidendrum*, western hemisphere, possibly nearly 1000). The species of orchids, as a whole, are distinctive, and extreme variation within species is not too common. Terrestrial species, especially those of temperate climates, are inclined to be more variable than are epiphytic ones. Species are inclined to be restricted in distribution although terrestrials and epiphytes growing at low elevations often range widely.

The greatest concentrations of orchids occur within twenty degrees of the equator. While some are found at low elevations, the great majority of them grow on mountains within the tropics. Malaysia and tropical America are richest in species and genera, with Africa a poor third. New Guinea probably contains more species than any comparable land area, although it is still not well known botanically. Colombia is perhaps the richest in species of any comparable area in the western hemisphere.

KEY TO THE SUBFAMILIES, TRIBES AND GENERA

a. Stamens 2, a third usually transformed into a large staminode; pollen granular, not united into masses or bodies..........Subfamily DIANDRAE (Tribe I CYPRIPEDILOIDEAE)

aa. Stamen 1, the laterals abortive or forming staminodes; pollen consolidated into masses or solid bodies (pollinia)..........Subfamily MONANDRAE

b. Caudicle and gland arising from the base of the pollinia; anthers erect or more or less resupinate, very closely adnate to the broad-based column, never deciduous after flowering; pollinia always granular (sectile)..........Tribe II OPHRYDOIDEAE

bb. Caudicle and gland arising from the apex of the pollinia; anthers erect or incumbent, the filaments short and slender, generally narrowly joined to the column, usually deciduous but if persistent soon withering.

c. Pollinia granular, soft; anthers commonly persistent but withering; inflorescence (normally) always terminal..........Tribe III POLYCHONDREAE

cc. Pollinia waxy or cartilaginous; anther commonly soon deciduous; inflorescence terminal or lateral..........Tribe IV KEROSPHAEREAE

I. Subfamily DIANDRAE, Tribe CYPRIPEDILOIDEAE. Two genera in Panama.

a. Stems elongated, leafy; leaves thin.......... 1. SELENIPEDIUM

aa. Stems very short or apparently none, leaves coriaceous.......... 2. PHRAGMIPEDIUM

II. Subfamily MONANDRAE, Division BASITONAE, Tribe OPHRYDOIDEAE.

a. One genus in Panama.......... 3. HABENARIA

III. Subfamily MONANDRAE, Division ACROTONAE, Tribe POLYCHONDREAE. Twelve genera distributed in five subtribes in Panama.

a. Anther more or less prone, incumbent.

b. Leaves not articulated, persistent; stems not cane-like.
c. Terrestrial herbs with fleshy roots; small or large rather showy purplish flowers .... 4. POGONIA
cc. Scandent herbs, usually epiphytic, without fleshy roots; flowers large, usually white .... 5. VANILLA
bb. Leaves articulated, caducous; stems cane-like.
c. Pollinia 8.
d. Base of the lip strongly gibbous or subsaccate, ornamented with two prominent calli; flowers relatively small .... 6. ELLEANTHUS
dd. Base of the lip not strongly gibbous or subsaccate, with or without calli at the base; flowers relatively very large .... 7. SOBRALIA
cc. Pollinia 4 .... 8. PALMORCHIS
aa. Anther more or less erect; rostellum erect or suberect.
b. Leaves not plicate-nerved, usually soft.
c. Roots fasciculated.
d. Lip uppermost, adaxial; flowers not resupinate.
e. Petals, and sometimes the lip, inserted on the column .... 12. PONTHIEVA
ee. Petals and lip not inserted on the column.
f. Lip inserted at the base of the column, free.
g. Sepals not united into a basal tube .... 11. CRANICHIS
gg. Sepals united at the base into a slender tube .... 9. STENOPTERA
ff. Lip united at the base to a cup formed of the united sepals, helmet-shaped .... 10. PRESCOTTIA
dd. Lip lowermost, abaxial; flowers resupinate .... 13. SPIRANTHES
cc. Roots not fasciculated, arising from the nodes on the lower part of the stem or rhizome .... 14. ERYTHRODES
bb. Leaves plicate-nerved, chartaceous or subcoriaceous .... 15. CORYMBORCHIS
IV. Subfamily MONANDRAE, Division ACROTONAE, Tribe KEROSPHAEREAE. Seventy-two genera, distributed in twenty-six subtribes, in Panama.
a. Series A. ACRANTHAE. Inflorescence normally terminal or by abortion of terminal inflorescence axillary in uppermost leaves. (See also LOCKHARTIA).
b. Viscid disc, when present, arising from the apex of the pollinia, commonly irregular, rudimentary or none.
c. Ovary articulated to the pedicel; pedicel persistent; stems slender, rigid, sometimes reduced, usually unifoliate.
d. Sepals all distinctly connate at the base.
e. Sepals also connate at their tips, open between tips and bases .... 18. CRYPTOPHORANTHUS
ee. Sepals not connate at their tips.
f. Sepals forming a narrow or campanulate tube at the base.
g. Inflorescence a raceme .... 17. PHYSOSIPHON
gg. Inflorescence a single flower, or rarely 2 flowers .... 19. MASDEVALLIA
ff. Sepals more or less rotate, not forming a narrow tube at the base .... 16. STELIS
dd. Sepals not all distinctly connate at the base, at least the dorsal sepal free or nearly free.
e. Blade of the petal transverse, i. e. strongly bilobed (except *L. eximia*) .... 21. LEPANTHES
ee. Blade of the petal not transverse, not strongly bilobed.
f. Petals inserted on the column-foot; lip with a hood-shaped callus or ligule at the base .... 22. ACOSTAEA
ff. Petals not inserted on the column-foot nor with a hood-shaped callus or ligule at the base.
g. Inflorescence terminal or at least subterminal on the secondary stems .... 23. PLEUROTHALLIS
gg. Inflorescence originating about the middle of the secondary stems .... 20. SCAPHOSEPALUM
cc. Ovary not articulated to the pedicel; pedicel caducous with the flower; stems slender or fleshy, 1- to several-flowered.
d. Pollinia without appendages, i. e. no viscid disc or caudicle.
e. Column very short; anthers sessile in the clinandrium, erect .... 24. MALAXIS
ee. Column elongated; anther terminal, incumbent .... 25. LIPARIS
dd. Pollinia appendaged, i. e. with at least a rudimentary viscid disc or a caudicle with a viscid apex.

e. Column footless; lip more or less connate with the base of the column.
f. Pollinia 4, two in each cell of the anther.
g. Lip geniculate at its junction with the column................ 26. Hexisea
gg. Lip not geniculate at its junction with the column.
h. Flowers large and showy; stems always pseudobulbose.. 29. Cattleya
hh. Flowers usually not large and showy; stems either pseudobulbose or ebulbose.
i. Lip with two large hollow horn-like processes; lip free or nearly so.. 28. Diacrium
ii. Lip without hollow horn-like processes; lip commonly connate with the column at base but not always so.. 27. Epidendrum
ff. Pollinia 8, four in each cell of the anther.
g. Pollinia of two sizes, unequal.. 31. Brassavola
gg. Pollinia of one size, equal.. 30. Laelia
ee. Column produced into a distinct foot at the base; lip hardly connate to the column or at most connate at the base of the column-foot.
f. Pollinia 4 or 6.
g. Leaves distichous and scattered along an elongated stem.
h. Pollinia 6.. 33. Platyglottis
hh. Pollinia 4.. 34. Isochilus
gg. Leaves not distichous on an elongated stem, terminal from pseudobulbs or short indurated stems....................... 32. Scaphyglottis
ff. Pollinia 8.. 35. Coelia
bb. Viscid disc distinct, regular, with the margins well defined, arising from the apex of the column.
c. Column with a foot; plants with pseudobulbs; pollinia 4, or 4 joined into two pairs.
d. Lip with a spur.. 37. Galeandra
dd. Lip without a spur.. 36. Polystachya
cc. Column footless; plants without pseudobulbs; pollinia 2.................. 38. Epidanthus
aa. Series B. Pleuranthae. Inflorescence lateral, arising near the base of the pseudobulb or in the axils of the lower leaves or sheaths. (This series contains two subseries.)
A. Subseries a. Sympodiales. Plants forming a sympodium, i. e. the stems approximate or superimposed and the apical growth manifestly terminal.
B. Pollinia without a stipe; viscid disc commonly rudimentary or the apex of the caudicle glutinous or none.
C. Rhizome short; terrestrial plants with the stems bulbose, usually partially buried in the ground; leaves plicate..................................
D. Lip with a spur.. 39. Calanthe
DD. Lip without a spur.. 40. Bletia
CC. Rhizome more or less elongated; plants epiphytic with pseudobulbose stems 1- to many-leaved; leaves plane or plicate.
D. Pseudobulbs homoblastic (i. e. of several nodes, only the terminal one of which bears leaves), fusiform, many-leaved; leaves plicate, thin; flowers relatively large.. 41. Chysis
DD. Pseudobulbs heteroblastic (i. e. of a single node with one or more terminal leaves), usually small; leaves coriaceous or fleshy, not plicate; flowers relatively small.. 42. Bulbophyllum
BB. Pollinia with a prominent stipe, sometimes short; viscid disc distinct.
C. Pollinia of a waxy texture, easily mashed.
D. Lip spurred or with a saccate base.. 43. Eulophia
DD. Lip not spurred nor saccate at the base.
E. Lateral sepals and column forming a prominent mentum; base of the leaves and peduncle not enclosed in a submembranaceous sheath.. 44. Warrea
EE. Lateral sepals and column-foot forming an inconspicuous mentum; base of the leaves and peduncle enclosed in a submembranaceous sheath.. 45. Govenia
CC. Pollinia cartilaginous in texture, not easily mashed.

D. Leaves convolute in vernation.
E. Pseudobulbs large, fusiform, homoblastic, many-leaved.
F. Flowers perfect, monomorphic; column twisted .... 46. MORMODES
FF. Flowers dimorphic or trimorphic (rarely perfect); column not twisted.
G. Column thick, straight, in male flowers usually with two retrorse antennae .... 47. CATASETUM
GG. Column slender, curved or arcuate, without retrorse antennae .... 48. CYCNOCHES
EE. Pseudobulbs short, heteroblastic, 1- to few-leaved.
F. Lip continuous with the base of the column or solidly attached to the short column-foot, not articulated, more or less prominently divided into an epichile and a hypochile or rarely entire.
G. Petals very much narrower than the sepals, usually inserted on the base of the column.
H. Epichile saccate and bucket-like .... 57. CORYANTHES
HH. Epichile not saccate .... 56. GONGORA
GG. Petals not distinctly narrower than the sepals, from a little narrower to broader.
H. Epichile saccate and bucket-like .... 57. CORYANTHES
HH. Epichile not saccate.
I. Lateral sepals connate and forming a distinct mentum at the base; flowers about 1.5 cm. long, fleshy .... 49. COELIOPSIS
II. Lateral sepals free or if connate not forming a distinct mentum at the base.
J. Lip entire .... 50. SIEVEKINGIA
JJ. Lip not entire, usually divided into a hypochile and an epichile.
K. Hypochile of lip concave-saccate; apex of lip shallowly 3-lobed, the epichile obscure .... 55. STANHOPEA
KK. Hypochile of lip usually not concave-saccate or if so then the lip distinctly divided and lobed.
L. Epichile or terminal lobe of lip narrowly lanceolate, acuminate .... 54. NEOMOOREA
LL. Epichile or terminal lobe of lip not narrowly lanceolate, acuminate.
M. Lateral lobes of the lip (pleuridia, mesochile) erect or at least not parallel to the epichile.
N. Rachis of inflorescence and sepals dorsally brown pilose-pubescent .... 51. KEGELIELLA
NN. Rachis of inflorescence and sepals not pubescent.
O. Lateral lobes of the lip joined by a large central callus; hypochile of the lip long, at least as long as the lateral lobes .... 52. ACINETA
OO. Lateral lobes of the lip not joined by a central callus; hypochile of the lip short and inconspicuous .... 53. PERISTERIA
MM. Lateral lobes of the lip (pleuridia) more or less parallel to the epichile, ensiform .... 55. STANHOPEA
FF. Lip articulated to the apex of the column-foot.
G. Inflorescence basal, i. e. arising from the base of the pseudobulb; lip usually provided with a long low callus.
H. Inflorescence consisting of a single flower .... 60. LYCASTE
HH. Inflorescence a few- to several-flowered raceme.
I. Flower with a conspicuous spur-like mentum .... 58. XYLOBIUM
II. Flowers without a conspicuous spur-like mentum .... 59. BIFRENARIA

GG. Inflorescence suprabasal, i. e. in the axils of the lower sheaths; lip usually provided with a transverse callus or crest.............. 61. Zygopetalum

DD. Leaves conduplicate in vernation.

E. Column produced into a foot and forming a mentum with the lateral sepals; rostellum hardly produced, emarginate.

F. Callus of the lip transverse, often flabellate, at the base of the lip; inflorescence suprabasal, i. e. in the axils of the sheaths or sheath-like leaves; pseudobulbs reduced or rudimentary.

G. Callus at the base of the lip pectinate or fringed.............. 64. Huntleya

GG. Callus at the base of the lip not pectinate or fringed.

H. Lip entire or but obscurely lobed.............. 62. Chondrorhyncha

HH. Lip lobed, or divided into a narrow basal and a broad apical part.............. 63. Warsczewiczella

FF. Callus of the lip longitudinal, often inconspicuous or rarely none; inflorescence borne from the base of a pseudobulb; pseudobulbs often well developed or forming elongated stems.

G. Lateral sepals forming a spur at their base about as long or longer than the blades of the sepals.............. 67. Cryptocentrum

GG. Lateral sepals not forming a long spur.

H. Sepals connate and forming a short tube at the base; lip not half as long as the sepals.............. 66. Trigonidium

HH. Sepals not connate and forming a tube at the base; lip usually at least half as long as the sepals.............. 65. Maxillaria

EE. Column footless; rostellum commonly produced, sometimes subulate or acute.

F. Anther incumbent; rostellum porrect or deflexed, never ascending.

G. Base of the lip spurred or saccate or appendaged at the base.

H. Base of lip forming a spur or deeply saccate.

I. Lateral sepals free.............. 68. Trichocentrum

II. Lateral sepals connate.............. 70. Rodriguesia

HH. Base of the lip with short to long appendages; lateral sepals usually connate and commonly spurred or saccate at the base.............. 69. Ionopsis

GG. Base of the lip neither spurred nor saccate nor with appendages.

H. Pollinia 2.

I. Clinandrium low, slightly excavated, margin entire and not hyaline.

J. Column winged near the stigma.............. 71. Trizeuxis

JJ. Column wingless near the stigma.............. 76. Brassia

II. Clinandrium with a high margin enfolding the anther or nearly so, or the column with spreading wings near the stigma.

J. Leaves articulated at the base.

K. Base of the lip enfolding the column and shortly adnate to it at its base.............. 72. Trichopilia

KK. Base of the lip not enfolding the column.

L. Lip inserted on the column near the middle.. 75. Aspasia

LL. Lip not inserted on the column near the middle.

M. Lateral sepals or all sepals and petals long-caudate; column not winged near the stigma.............. 76. Brassia

MM. Lateral sepals or all sepals and petals not caudate, or if so then column winged near the stigma.

N. Base of the lip forming a shallow sac.... 73. Mesospinidium

NN. Base of the lip not forming a shallow sac.

O. Column with a pair of narrow stelidia at the middle; lip usually unlobed, pandurate or retuse .... 79. LEOCHILUS

OO. Column lacking narrow stelidia at the middle; lip various.

P. Lip long-unguiculate; flowers small .. 80. SIGMATOSTALIX

PP. Lip not long-unguiculate; flowers usually not small.

Q. Lip erect and parallel or contiguous to the column at the base; calli on the lip usually 2, parallel and not joined; column usually not winged .... 74. ODONTOGLOSSUM

QQ. Lip spreading (usually approaching a right angle) from the column; calli on the lip various but if 2 then usually joined; column usually winged at the apex.

R. Lip usually relatively large and not sharply lobed, usually lacking calli except at the base; flowers white .... 77. MILTONIA

RR. Lip usually relatively small and distinctly 3-lobed, usually provided with calli above the base (as well as often at the base); flowers commonly yellow to maroon .... 78. ONCIDIUM*

JJ. Leaves not articulated, i. e. marcescent; plants with densely equitant-leaved, elongated stems, without pseudobulbs .... 81. LOCKHARTIA

HH. Pollinia 4; lip with a retrorse callus near the base ...... 82. ORNITHOCEPHALUS

FF. Anther erect on the back of the column or erect on the apex of the column under the clinandrium; rostellum erect or ascending.

G. Column provided with stiff hairs .... 85. TELIPOGON

GG. Column not provided with stiff hairs.

H. Clinandrium margins small, not almost surrounding the anther .... 83. NOTYLIA

HH. Clinandrium margins large, almost forming a calyptra over the anther .... 84. MACRADENIA

AA. Subseries b. MONOPODIALES. Plants forming a monopodium, i.e. the stems having infinite apical growth.

B. Column with an infrastigmatic ligule; stems with equitant leaves .... 86. DICHAEA

BB. Column without an infrastigmatic ligule; stems not having equitant leaves, plants sometimes leafless .... 87. CAMPYLOCENTRUM

---

* *Oncidium, Miltonia, Odontoglossum, Brassia, Aspasia, Leochilus* and *Mesospinidium* are only one genus, naturally, for they merge completely. However for purposes of convenience they are best left apart. The first three mentioned are all well known and, except for borderline species, even the amateur can soon learn to distinguish them easily by their aspect.

1. SELENIPEDIUM Reichb. f.

Selenipedium Reichb. f. Xenia Orch. 1:3, *t. 2.* 1854; emend. Pfitz. in Engl. Pflanzenr. IV. 50 (Heft 12): 27. 1903.

Solenipedium Beer, Prakt. Stud. Orch. 310. 1854.

Tall terrestrial herbs with leafy, often branched stems. Leaves narrow, many-nerved, inarticulate. Inflorescence terminal, racemose, many-flowered. Flowers small to medium-sized, resupinate. Sepals spreading, the dorsal free, the laterals connate nearly to their apices. Petals smaller than the sepals, free. Lip calceiform, saccate. Column short, terete. Fertile stamens 2, the third stamen (staminodium) sterile. Stigma wider than the staminodium, papillose, trisulcate. Capsule fusiform, trilocular, crowned by the marcescent perianth.

One species in Panama.

1. Selenipedium chica Reichb. f. Xenia Orch. 1:3, *t. 2.* 1854; Pfitz. in Engl. Pflanzenr. IV. 50 (Heft 12): 27. 1903; Ames, Sched. Orch. 2:1, *t. 1.* 1923.

Stems leafy, erect, slender, up to about 5 m. tall. Leaves when mature 15–30 cm. long and 1.5–5 cm. broad, elliptic-lanceolate to lanceolate, acuminate, submembranaceous, many-nerved, inarticulate, sparsely pubescent dorsally, especially along the nerves, or becoming glabrate, contracted at the base into a cylindric sheath covering the stem. Inflorescence terminal, many-flowered, densely pubescent; flowers small to medium-sized, opening in succession, soon deciduous if not fertilized; bracts normally 10–15 mm. long, lanceolate, acute, puberulent. Dorsal sepal about 2 cm. long and 1 cm. broad, elliptic-oval, acute, puberulent dorsally toward the base. Lateral sepals together about 2 cm. long and 1 cm. broad, elliptic-oval, acute, connate nearly to their apices. Petals up to 2 cm. long and about 2 mm. broad, linear, puberulent dorsally along the mid-nerve and within near the base. Labellum 2–3 cm. long and 1–1.8 cm. broad in natural position, calceiform, margins strongly involute.

Endemic in Panama.

"Panama": without data, *Duchassaing*. panamá: in foothills 20 miles northeast of Panama City, alt. 60–90 m., *Powell 258;* northeast of Panama City, *Powell 3007*. canal zone: Ancon Hill, *Killip 3043;* Cañon of Río Chagres, alt. 70–80 m., *Steyermark & Allen 17506*.

This is undoubtedly the largest terrestrial orchid in the Americas.

2. PHRAGMIPEDIUM (Pfitz.) Rolfe

Phragmipedium (Pfitz.) Rolfe in Orch. Rev. 4:331. 1896; Pfitz. in Engl. Pflanzenr. IV. 50 (Heft 12): 42. 1903, as *Phragmopedilum*.

Paphiopedilum § *Phragmopedilum* Pfitz. in Engl. Bot. Jahrb. 25:527. 1898.

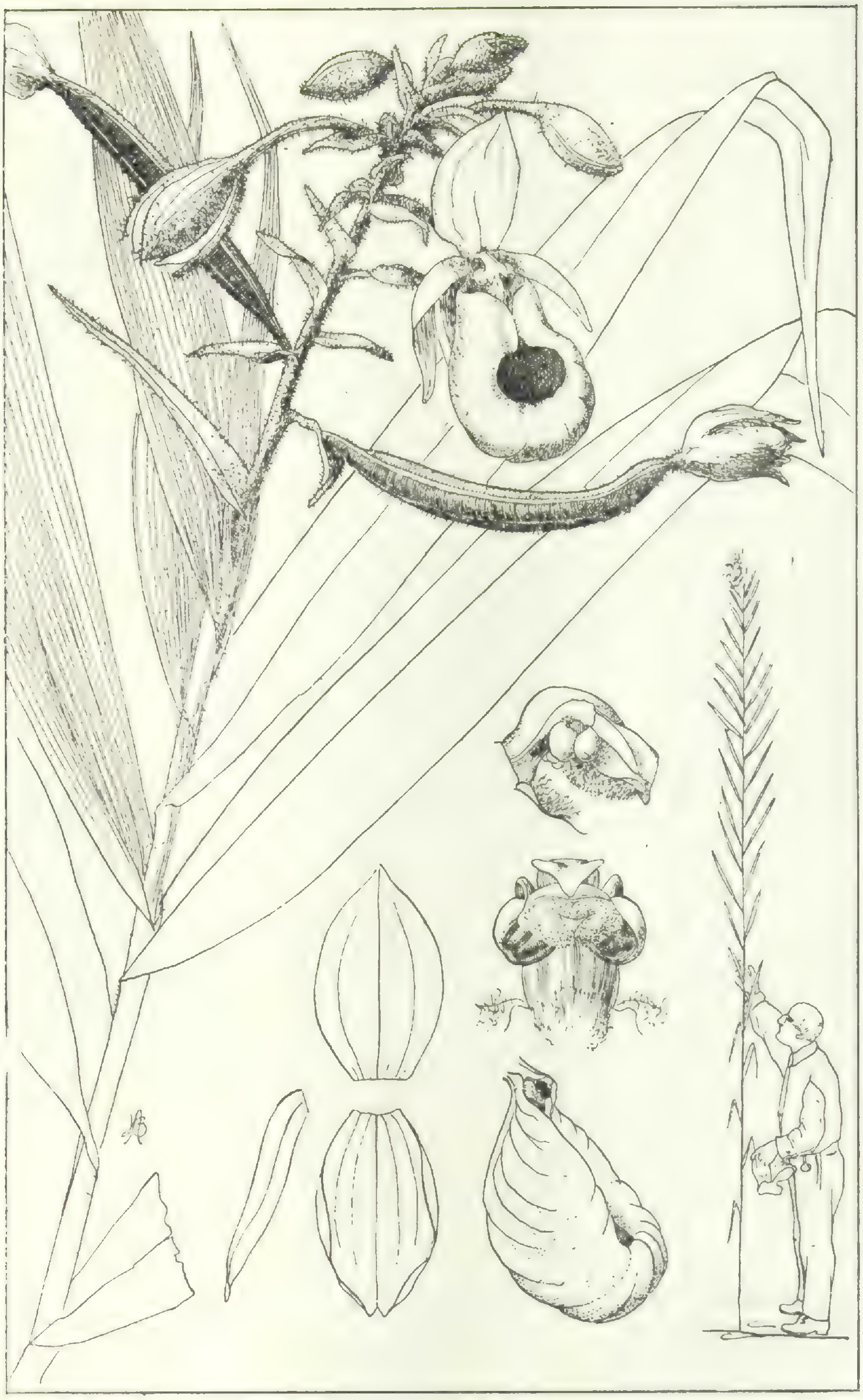

Fig. 64. *Selenipedium chica*

Terrestrial or epiphytic herbs with very short stems. Leaves duplicative, coriaceous, sulcate above and carinate below, inarticulate. Inflorescence terminal, racemose or paniculate, several-flowered; flowers medium to large-sized, resupinate. Sepals spreading, the dorsal free, the laterals connate almost to their apices. Petals narrower than the sepals but often much elongated and caudate. Lip calceiform, saccate. Column short. Fertile anthers 2, the third stamen (staminodium) sterile, stigma deflexed from the apex of the column, subparallel to the ovary or subrotund, papillose. Capsule long-fusiform, trilocular, the perianth deciduous.

Two species in Panama and about a dozen species in South America. Often in cultivation.

a. Petals mostly more than 30 cm. long when mature; leaves lorate.......... 1. P. CAUDATUM
aa. Petals mostly less than 10 cm. long when mature; leaves linear or linear-ligulate.......... 2. P. LONGIFOLIUM

1. PHRAGMIPEDIUM CAUDATUM (Lindl.) Rolfe in Orch. Rev. 4:332. 1896; Pfitz. in Engl. Pflanzenr. IV. 50 (Heft 12): 52. 1903, in synon; L. Wms. in Ann. Missouri Bot. Gard. 26:279. 1939.

Cypripedium caudatum Lindl. Gen. & Sp. Orch. Pl. 531. 1840.
Cypripedium Humboldti Warsz. ex Reichb. f. in Bot. Zeit. 10:691. 1852.
Cypripedium Warszewiczianum Reichb. f. loc. cit. 692. 1852.
Paphiopedilum caudatum Pfitz. in Engl. Bot. Jahrb. 19:41. 1894; Kerch. Orch. 454. 1894.
Cypripedium caudatum var. *Warscewiczii* Hort. in Kerch. loc. cit. 1894.
Cypripedium caudatum var. *roseum* Hort. in Kerch. loc. cit. 1894.
Phragmopedilum Warszewiczianum Schltr. in Fedde Rep. Sp. Nov. Beih. 17:9. 1922.

Stems very much reduced, leafy. Leaves 15–20 cm. long, 3–5 cm. broad, lorate, obtuse, apex shallowly and unequally bilobed, coriaceous, inarticulate, glabrous. Inflorescence terminal, few-flowered, exceeding the leaves; rachis velutinous; flowers large; bracts 3–6 cm. long, obtuse, subrotund, clasping the rachis. Dorsal sepal 10–15 cm. long and 1.5–2 cm. broad at the base, lanceolate, minutely pubescent dorsally. Lateral sepals together about 8–11 cm. long and 2.5–4 cm. broad, ovate-lanceolate to lanceolate, connate to their apices. Petals 30–70 cm. long when mature, 0.5–1 cm. broad at the base, long-caudate, puberulent. Lip 5–6 cm. long and about 2.5–3 cm. broad in natural position, calceiform, margins involute, lateral edges of the opening pilose. Ovary velutinous.

Panama, Venezuela (?), Colombia, Ecuador and Peru.

CHIRIQUÍ: probably Volcán de Chiriquí, *Warscewicz;* vicinity of Casita Alta, Volcán de Chiriquí, alt. 1500–2000 m., *Woodson, Allen & Seibert 962.*

The description is based on the specimens collected by Woodson, Allen and Seibert. No living material was available, and the plant is difficult to describe from dried material. The form of the species in Panama is the superior horticultural form and for this reason has been almost exterminated there. The species is difficult to grow at sea-level.

2. PHRAGMIPEDIUM LONGIFOLIUM (Warsz. & Reichb. f.) Rolfe in Orch. Rev. 4:33. 1896.

Cypripedium longifolium Warsz. & Reichb. f. in Bot. Zeit. 10:690. 1852; Hook. f. in Bot. Mag. 98: *t. 5970.* 1872.
Selenipedium longifolium Reichb. f. Xenia Orch. 1:3. 1854.
Cypripedium Hincksianum Reichb. f. in Gard. Chron. n. s. 9:202. 1878.
Paphiopedilum longifolium Pfitz. in Engl. & Prantl, Nat. Pflanzenfam. II. 6:84. 1888.
Paphiopedium longifolium Kerch. Orch. 455. 1894.
Paphiopedilum Hincksianum Pfitz. in Engl. Bot. Jahrb. 19:41. 1894.

Stems much reduced, leafy. Leaves up to 80 cm. long and 1–4 cm. broad, linear or linear-ligulate, canaliculate, acute, inconspicuously and unequally bilobed at the apex, inarticulate, distichous. Inflorescence terminal, several-flowered, glabrous; flowers medium-sized; bracts 4–9 cm. long and 1–2 cm. broad, acute, distichous, glabrous. Dorsal sepal 3–5.5 cm. long and 1–1.8 cm. broad, lanceolate or lanceolate-acuminate. Lateral sepals 2.5–5 cm. long and 1.7–2.5 cm. broad, ovate-lanceolate. Petals 5–10 cm. long and 0.4–0.8 cm. broad, linear-lanceolate, caudate, pubescent within, especially at the base. Lip 2.5–4 cm. long and about half as broad, calceiform, pubescent within, at least at the base, margins involute.

Costa Rica, Panama and Colombia.

CHIRIQUÍ: in barranca west of Caldera River, alt. 3800 feet, *Powell 308;* without locality, *Warscewicz.* COCLÉ: valley of the upper Río Mata Ahogado, alt. 350 m., *Allen 145;* Las Margaritas, *Bouché 4.* PANAMÁ: without locality, *Seemann 1114.*

3. HABENARIA Willd.

HABENARIA Willd. Sp. Pl. 4:44. 1805; Kränzl. Orch. Gen. & Sp. 1:174. 1901; Ames, Orch. 4:1–288. 1910.

Gymnadenia R. Br. in Aiton, Hort. Kew. ed. 2, 5:191. 1813.
Platanthera L. C. Rich. in Mém. Mus. Par. 4:48. 1818.
Limnorchis Rydb. in Mem. N. Y. Bot. Gard. 1:104. 1900.

Terrestrial or palustrine herbs with cauline or basal leaves or rarely the leaves reduced to bracts. Leaves thin to fleshy, usually prominent. Inflorescence few- to many-flowered, spicate or racemose; flowers various; bracts often large and conspicuous. Sepals subequal, free or connate at the bases, the dorsal erect, usually concave, the laterals usually spreading. Petals similar to the sepals but usually smaller, or more or less deeply bifid (rarely trifid or polyfid). Lip simple or 3 or more-lobed, often adnate to the column, spreading or pendulous, spurred at the base. Column short, footless. Stigmas 2 or 1 stigma 2-lobed, often elongated into short or comparatively long processes. Anther erect, rarely more or less resupinate, persistent; pollinia (or pollen) granular, with short or sometimes long caudicles from the base.

A polymorphic genus of world-wide distribution, probably one of the oldest genera in the family. There are many more generic synonyms than those cited but the ones given are the essential ones for the Panama flora. A good account of the North American species known to 1910 will be found in Ames, Orchidaceae, Vol. 4.

a. Petals entire or merely toothed; lip entire, toothed at the base or 3-lobed.
b. Petals lanceolate .... 1. H. ALATA
bb. Petals not lanceolate .... 3. H. PETALODES
aa. Petals bifid; lip 3-lobed.
b. Palustrine or aquatic plants .... 8. H. REPENS
bb. Not palustrine nor aquatic plants.
c. Sepals less than 5 mm. long (mostly 3 mm.) .... 7. H. HEPTADACTYLA
cc. Sepals much more than 5 mm. long.
d. Lateral lobes of the lip very much shorter than the mid-lobe; petals short .... 4. H. AVICULA
dd. Lateral lobes of the lip about as long as the mid-lobe or longer; petals normal.
e. Bracts of the inflorescence large and leaf-like; flowers mostly less than 5... 6. H. PAUCIFLORA
ee. Bracts of the inflorescence not large and leaf-like; flowers mostly more than 5.
f. Spur 40–50 mm. long; leaves ensiform to linear-lanceolate .... 5. H. BICORNIS
ff. Spur 15–25 mm. long; leaves elliptic-oblong to ovate-lanceolate.. 2. H. MONORRHIZA

Fig. 65. *Habenaria alata*

1. Habenaria alata Hook. Exot. Fl. 3: *t. 169.* 1827; Ames, Orch. 4:273. 1910; Bot. Mus. Leafl. Harv. Univ. 3:20, *fig.* 1934.

Erect or ascending terrestrial herbs with leafy stems, 2–7 dm. tall. Leaves 6–14 cm. long and 0.8–2 cm. broad, linear-lanceolate to lanceolate, acute or acuminate, reduced to bracts below and above. Inflorescence subracemose, up to 2 dm. long, densely flowered; flowers pale green. Dorsal sepal 6–10 mm. long and 5–7 mm. broad, ovate to suborbicular, concave. Lateral sepals 7–10 mm. long and 3.5–4.5 mm. broad, lanceolate to triangular-lanceolate, acute or acuminate. Petals 5.5–10 mm. long and 2–2.5 mm. broad, lanceolate, acute or obtuse, auriculate at the base on the anterior margin. Lip 5.5–8 mm. long and about 2 mm. broad, linear-lanceolate to lanceolate, entire, auriculate or dentate on either side at the base; spur up to 13 mm. long, recurved, subclavate. Ovary prominently winged when mature.

Neotropical.

CANAL ZONE: Barro Colorado Island, *Kenoyer 249;* Ana Lago and Corozal, *Powell 316, 317, 318, 321, 3403.*

The Panamanian material is somewhat atypical.

2, Habenaria monorrhiza (Sw.) Reichb. f. in Ber. Deut. Bot. Ges. 3:274. 1885.
Orchis monorrhiza Sw. Nov. Gen. & Sp. Prodr. 118. 1788.

Erect, slender, terrestrial herbs up to about 12 dm. tall. Leaves 3–13 cm. long and 1.5–4 cm. broad, elliptic-oblong to lanceolate to ovate-lanceolate, acute or acuminate, margins chartaceous, reduced to bracts upward. Inflorescence a densely flowered raceme up to about 20 cm. long; flowers white. Dorsal sepal 5–8 mm. long and 4–5.5 mm. broad, ovate or suborbicular-ovate, obtuse, cucullate. Lateral sepals 4–8 mm. long and 3–4 mm. broad, ovate, oblique, obtuse. Petals 5–8 mm. long, bipartite, the lobes subequal; anterior lobe filiform; posterior lobe elliptic or elliptic-oblong, obtuse or acutish. Lip about 7–10 mm. long, trilobate; lateral lobes filiform, spreading; mid-lobe linear-ligulate; spur 15–25 mm. long, pendulous, slender. Ovary somewhat winged.

Guatemala to Panama, the West Indies and South America.

chiriquí: Boquete, alt. 1150 m., *Terry & Terry 1641*. coclé: hills south of El Valle de Antón, alt. 600–800 m., *Allen 2771*.

3. Habenaria petalodes Lindl. Gen. & Sp. Orch. Pl. 316. 1835.

Habenaria petalodes var. *micrantha* Reichb. f. Beitr. Orch. Centr.-Am. 5. 1866.
Habenaria Warszewiczii Schltr. in Anex. Mem. Inst. Butantan 1^2:25. 1921.

Erect terrestrial herbs up to about 6 dm. tall. Leaves 4–17 cm. long and 1–5.5 cm. broad, lanceolate to elliptic or elliptic-oblong, acute or somewhat acuminate, crowded near the middle of the stem, reduced to bracts above. Inflorescence up to about 25 cm. long, strict, densely flowered; bracts up to 3 cm. long, lanceolate to lanceolate-ovate, acute or acuminate. Dorsal sepal 6–10 mm. long and 4–6 mm. broad, ovate to broadly ovate, obtuse, cucullate. Lateral sepals 7–10 mm. long and 3.5–5 mm. broad, semi-lunate or oblong-arcuate, obtuse. Petals 5–9 mm. long and 3.5–6.5 mm. broad, oblong to subquadrate to triangular-oblong and cuneate at the base, dilated toward the truncate, bi- or tridentate apex. Lip 7–12 mm. long and about 1 mm. broad, linear, acute or obtuse, sometimes dilated at the apex and sometimes with obscure teeth on either side at the base; spur up to 30 mm. long (mostly about 20 mm.), slender, straight.

Panama, Colombia, Brazil and Paraguay.

"panama": *Warszewicz*. coclé: Nata, alt. about 50 m., *Allen 820*. panamá: Taboga Island, *Killip 3173, 3190, 3191*; same locality, alt. 0–350 m., *Allen 1280*. canal zone and panamá: Chorerra, Tapia, Sieba Terra, Sosa Hill, Ancón Hill, Juan Diaz Range, *Powell 212, 260, 261, 262, 264, 265, 266, 326, 327, 328, 330, 331, 332, 336, 337, 339, 346, 3417, 3419, 3421*.

I have reported a specimen of this, in error, as *H. strictissima* var. *odontopetala* (Reichb. f.) L. Wms., in Ann. Missouri Bot. Gard. 27:271. 1940.

4. Habenaria avicula Schltr. in Fedde Rep. Sp. Nov. Beih. 17:138. 1921.

Habenaria patentiloba Ames in Proc. Biol. Soc. Wash. 34:151. 1921.

Slender, erect, terrestrial herbs up to 4.5 dm. tall, with leafy stems. Leaves 7–15 cm. long and 1–3.5 cm. broad, lanceolate, elliptic to elliptic-oblong, obtuse,

acute or acuminate, reduced to bracts above and below. Inflorescence laxly to densely flowered; bracts 1–2.5 cm. long and 0.4–0.8 cm. broad, lanceolate to ovate-lanceolate, acute or acuminate. Dorsal sepal about 4–6 mm. long and as broad, suborbicular, concave. Lateral sepals 6–10 mm. long and 4–7.5 mm. broad, broadly sub-lunate, spreading. Petals 4–6 mm. long and about 3 mm. broad, bifurcate, the lobules or teeth acute, the anterior tooth shortest. Lip 12–16 mm. long and 1–2 mm. broad, linear, provided with a pair of narrow basal teeth about 1–3.5 mm. long; spur 15–30 mm. long, slightly recurved.

Endemic in Panama.

"PANAMA": *Joseph; Purdom.* PANAMÁ: Orange River Valley, *Killip 3124.* CANAL ZONE: near Fort Kobe, *Allen 2023;* hills near Summit, *Allen 2251;* foothill savannahs east of city, *Powell 162.*

5. HABENARIA BICORNIS Lindl. Gen. & Sp. Orch. Pl. 309. 1835.

Erect terrestrial herbs up to 6.5 dm. tall, with leafy stems. Leaves 5–25 cm. long and 0.5–1.5 cm. broad, ensiform to linear-lanceolate, acute or acuminate. Inflorescence a many-flowered raceme; bracts 1–3 cm. long, lanceolate, acuminate. Dorsal sepal 6–8 mm. long and 4–6 mm. broad, ovate-orbicular, cucullate, obtuse or acute, apiculate. Lateral sepals 8–10 mm. long and 4–5 mm. broad, semi-lunate, acute, apiculate. Petals bifid; posterior lobe 5–6 mm. long and 1.5–2 mm. broad, acute, arcuate; anterior lobe 6–9 mm. long and about 1 mm. broad, linear-filiform, acute, arcuate. Lip tripartite; the mid-lobe 7–10 mm. long and 1–2 mm. broad; lateral lobes 9–12 mm. long and 1–1.5 mm. broad, arcuate-spreading, acute; spur 40–50 mm. long, slender, subclavate.

Panama, the West Indies.

PANAMÁ: near Pacora, *Powell 315.* CANAL ZONE: Las Sabanas, *Pittier 6792.*

6. HABENARIA PAUCIFLORA (Lindl.) Reichb. f. in Bonplandia 2:10. 1854; L. Wms. in Ann. Missouri Bot. Gard. 26:280. 1939.

Bonatea pauciflora Lindl. Gen. & Sp. Orch. Pl. 329. 1835.
Habenaria setifera Lindl. in Ann. Nat. Hist. 4:381. 1840; Ames, Orch. 4:209, *t. 69.* 1910; in Bot. Mus. Leafl. Harv. Univ. 3:35, *fig. 1, p. 23.* 1934.
Habenaria spathacea Rich. & Gal. in Ann. Sci. Nat. III, 3:29. 1845.

Erect terrestrial herbs up to 5.5 dm. tall. Leaves 4–12 cm. long and 0.3–1.8 cm. broad, linear-lanceolate to elliptic-lanceolate, acute or acuminate, sometimes much reduced, usually partly sheathing the stem, reduced to bracts above. Inflorescence few-flowered (rarely more than 5-flowered); bracts similar to the leaves but smaller. Dorsal sepal 9–12 mm. long and 5–8 mm. broad, ovate-lanceolate to ovate, apiculate, cucullate. Lateral sepals 8–12 mm. long and 3.5–5 mm. broad, triangular-lanceolate, subfalcate, acute, acuminate or apiculate. Petals bipartite; anterior lobe 6–10 mm. long and up to 1 mm. broad, subfiliform, somewhat arcuate; posterior lobe 8–10 mm. long and 3–4 mm. broad, lanceolate or elliptic-lanceolate, acute, somewhat arcuate. Lip tripartite; the lateral lobes divergent and subequal to the mid-lobe in length; mid-lobe 10–14 mm. long and up to 2 mm. broad; spur 2.5–6 cm. long, subclavellate.

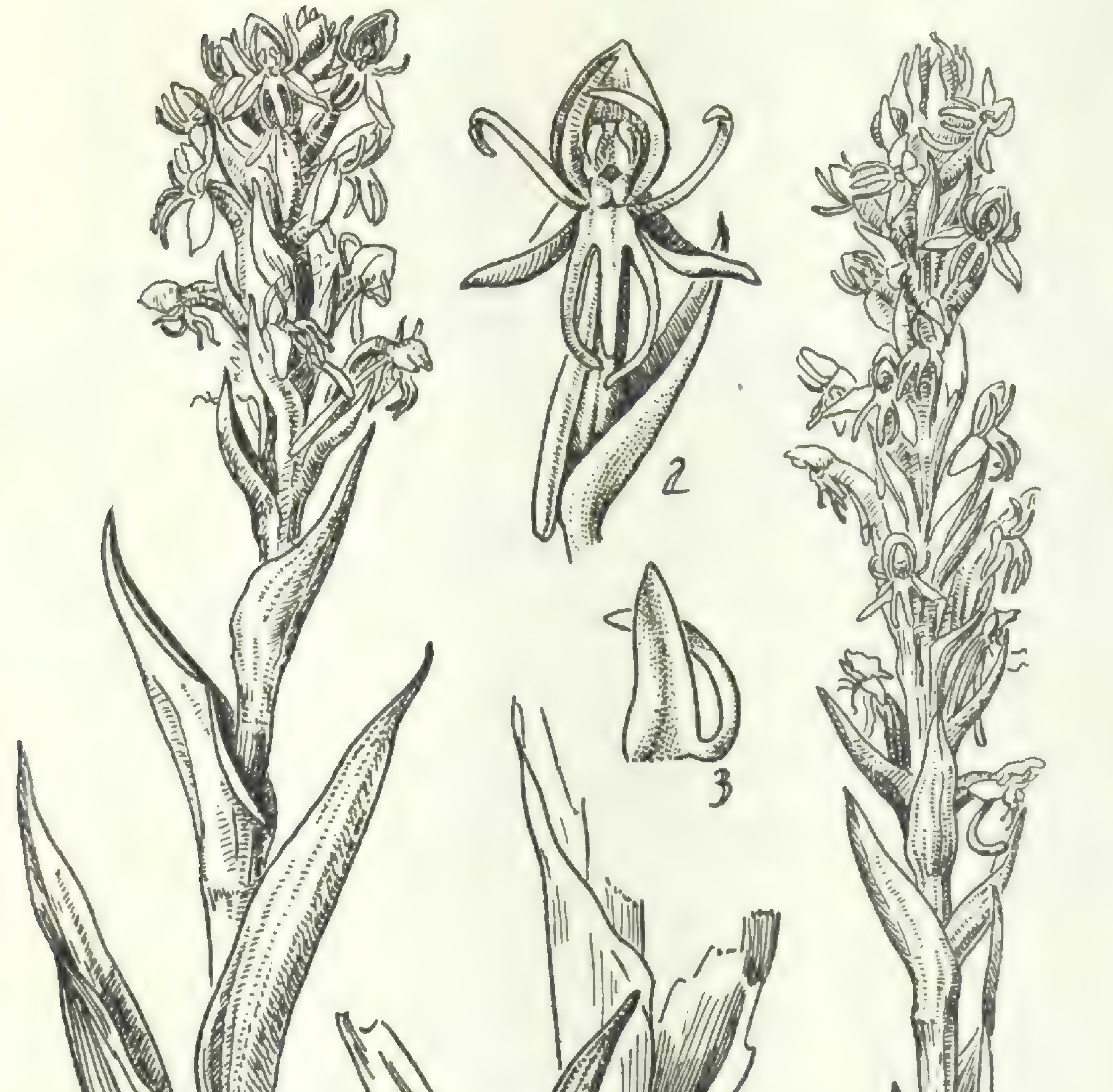

Fig. 66. *Habenaria repens*

Mexico to Argentina.

CHIRIQUÍ: Llanos del Volcán, *Seibert 326.* PANAMÁ: Campana to Chica, *Allen 2653;* Pacora to Chepo, *Woodson, Allen & Seibert 1665.*

An extremely variable species which has twenty or more synonyms.

7. HABENARIA HEPTADACTYLA Reichb. f. in Linnaea 22:812. 1849.

Slender, erect, terrestrial herbs up to 3.5 dm. tall. Leaves up to 7 cm. long, linear-filiform, aristate, reduced to bracts above. Inflorescence short, several-flowered, more or less secund; bracts up to 1.5 cm. long, ovate-lanceolate, long-acuminate; flowers small for the genus. Dorsal sepal 3–3.5 mm. long and 2–2.5 mm. broad, ovate, obtuse, cochleate, 3-nerved. Lateral sepals 3.5–4 mm. long and 1.2–1.5 mm. broad, lanceolate, acute, 3-nerved. Petals 2.5–3 mm. long, bipartite; the segments subequal or the outer shorter, lanceolate, acute, somewhat arcuate. Lip 3-lobed; the mid-lobe linear, 3–4.5 mm. long and about 0.5 mm. broad, linear, obtuse; lateral lobes 2.5–3.5 mm. long and 0.4–0.6 mm. broad, linear, obtuse, spreading; spur 10–12 mm. long, recurved, slightly saccate at the tip.

Panama, Colombia, Venezuela, British Guiana and Brazil.

WITHOUT LOCALITY: *Bouché 7.* PANAMÁ: near Arraiján, alt. about 15 m., *Woodson, Allen & Seibert 1406.*

8. HABENARIA REPENS Nutt. Gen. N. Am. Pl. 2:190. 1818; Ames, Orch. 4:216. 1910; in Bot. Mus. Leafl. Harv. Univ. 3:35, *fig. p. 23.* 1924.

Erect, slender, palustrine or aquatic herbs up to about 1 m. tall. Leaves up to 20 cm. long and 0.5–2.3 cm. broad, linear-elliptic to elliptic-lanceolate, acute or acuminate, reduced to bracts upward. Inflorescence a densely flowered raceme; flowers green. Dorsal sepals 4–7.5 mm. long and 3–5 mm. broad, oval to suborbicular-ovate, cochleate, apiculate. Lateral sepals 4–8 mm. long and 2–3 mm. broad, ovate to lanceolate-oval, oblique, apiculate. Petals 4–9 mm. long, bipartite, the lobes subequal; anterior lobe filiform; posterior lobe 1–2 mm. broad, linear-lanceolate to lanceolate, arcuate. Lip 5–10 mm. long and 1–2.5 mm. broad across the base, trilobate, the lobes subparallel; lateral lobes filiform; mid-lobe linear-lanceolate, usually a little shorter than the laterals; spur 8–15 mm. long, slender.

Southeastern United States, Guatemala, British Honduras, Nicaragua, Costa Rica, Panama, the West Indies and South America.

CANAL ZONE: Barro Colorado Island, *Bailey & Bailey 663; Dodge 3483; Woodworth & Vestal 55A, 65A.*

Often found in floating debris and in very wet places. The illustration, fig. 66, is redrawn from Ames, Orch. 1:51, *t. 16.* 1905.

4. POGONIA Juss.

Pogonia Juss. Gen. 65. 1789.

Triphora Nutt. Gen. N. Am. Pl. 2:192. 1818.
Cleistes L. C. Rich. in Mém. Mus. Par. 4:31. 1818.

Rhizome or tuber-bearing, leafy or leafless terrestrial herbs. Sepals subequal, free, erect or rarely spreading. Petals similar to the sepals or shorter and broader, usually erect. Lip erect, simple or 3-lobed, sessile or unguiculate, plane or with various lamellate or thickened nerves, spurless. Column elongated, wingless, footless; stigma oblong or broader; clinandrium more or less raised, entire or denticulate; anther subincumbent or apparently erect, substipitate (at least in some species); pollinia 2 masses, granular.

Ames (Orch. 7:7. 1922), in his account of this group of allied genera, separates *Cleistes (Pogonia rosea)* from *Pogonia* (typified by *P. ophioglossoides*) on the basis of simple pollen grains for *Pogonia* and compound pollen grains for *Cleistes*. However the so-called *Cleistes* seem to have simple pollen grains as often as not. The case for maintaining *Triphora* as a distinct genus is much better and is based on better characters. It is a matter of choice whether or not it is maintained.

a. Lip with two stipitate processes at the base; lamina simple........................ 1. P. rosea
aa. Lip without stipitate processes at the base; lamina 3-lobed.
  b. Apex of the lip, at least, verrucose........................ 4. P. cubensis
  bb. Apex of the lip, nor any part, verrucose.
    c. Cauline leaves well developed........................ 2. P. mexicana
    cc. Cauline leaves none or very much reduced........................ 3. P. Wagneri

1. Pogonia rosea (Lindl.) Hemsl. in Godm. & Salvin, Biol. Centr.-Am. Bot. 3:304. 1884.

Cleistes rosea Lindl. Gen. & Sp. Orch. Pl. 410. 1840.

Tall, slender, erect, terrestrial herbs up to 1.5 m. tall (Panamanian material up to 0.7 m. tall). Leaves 3–12 cm. long, 0.8–2.5 cm. broad, lanceolate, obtuse or acute, sessile and clasping the stem, apparently rather thick when fresh. Inflorescence of 1 or 2 rather large and showy flowers in the axils of the upper leaves. Dorsal sepal 5–6.5 cm. long and 0.6–0.8 cm. broad, linear-elliptic to lanceolate-elliptic, acute. Lateral sepals 5.5–6.5 cm. long and 0.8–1.1 cm. broad, linear-lanceolate to lanceolate, acute. Petals 5–6.5 cm. long and 1–1.6 cm. broad, elliptic to elliptic-oval, acuminate. Lip 4.5–5.5 cm. long and 1.6–3 cm. broad, broadly oblanceolate to narrowly obovate, obtuse, the median line of the lip callus-thickened or lamellate, lacerate toward the apex, with two stipitate processes at the base.

Panama, Colombia, Venezuela, British Guiana, possibly also in Costa Rica, and doubtless in other of the South American countries,—the "West Indies" according to Hemsley.

coclé: *Seibert 594.* canal zone: *Powell 113, 3395, 3400.* "Panama," *Duchassaing.*

Fig. 67. *Pogonia rosea*

Mr. Powell reported a white-flowered form of the species.

2. Pogonia mexicana S. Wats. in Proc. Am. Acad. 26:154. 1891.

Triphora mexicana Schltr. in Fedde Rep. Spec. Nov. Beih. 17:139. 1921; Ames, Orch. 7:40, *t. 109, f. 5–6.* 1922.

Weak terrestrial herbs up to 27 cm. tall, with leaf-bearing stems. Leaves 8–20 mm. long and 5–17 mm. broad, narrowly to broadly ovate, obtuse or acute. Inflorescence of 1–3 single flowers borne in the axils of the upper leaves (or leaf-like bracts?). Dorsal sepals 10–17 mm. long and about 2 mm. broad, linear to linear-oblanceolate, obtuse or acute. Lateral sepals 10–17 mm. long and 1.5–3 mm. broad, linear to narrowly elliptic, subfalcate, acute. Petals 9–17 mm. long and 1–3 mm. broad, linear to linear-elliptic, subfalcate, acute or obtuse. Lip 10–16 mm. long and 5–9 mm. broad, narrowly oval to obovate in outline, conspicuously narrowed to the base, 3-lobed; lateral lobes obtuse, subtriangular, terminal lobe suborbicular to deltoid; disc trilamellate.

Mexico, Guatemala and Panama.

canal zone: *Bevins.*

Very close if not the same as *Pogonia trianthophora* (Sw.) BSP.

3. Pogonia **Wagneri** (Schltr.) L. Wms., comb. nov.

Triphora Wagneri Schltr. in Fedde Rep. Sp. Nov. 17:139. 1921.

Small, leafless, erect, terrestrial herbs up to 7.5 cm. tall. Inflorescence 1-flowered, the flower erect. Dorsal sepal about 12 mm. long, ligulate, obtuse. Lateral sepals about 12 mm. long, ligulate, obtuse, falcate. Petals a little shorter and a little broader than the dorsal sepal, ligulate, obtuse, subfalcate-oblique. Lip about 10 mm. long and 5 mm. broad, narrowly obovate-cuneate in outline, prominently 3-lobed near the apex; lateral lobes obliquely ovate, obtuse; mid-lobe semi-ovate, obtuse, somewhat undulate; disc with 3 thickened, subverrucose nerves toward the apex.

Known only from Panama.

chiriquí and veraguas: *Wagner 1778.*

The description is taken from the original and a manuscript analysis.

4. Pogonia cubensis Reichb. f. in Nederl. Kruidk. Arch. 4:322. 1850, as *P. rubensis* by error.

Triphora cubensis Ames, Sched. Orch. 7:35. 1924.

Small terrestrial herbs up to 15 cm. tall. Leaves few, reduced to sheathing bracts, often much reduced above, 0.8–2 cm. long and 0.4–1 cm. broad, lanceolate to suborbicular. Inflorescence several-flowered, the pedicels of the lower flowers often elongated and hence the raceme often appearing subcorymbose. Dorsal sepal 7–8 mm. long and 1–1.5 mm. broad, linear to linear-lanceolate, obtuse. Lateral sepals similar to the dorsal sepal except more or less arcuate. Petals 7–7.5

mm. long and 1–1.2 mm. broad, narrowly elliptic to narrowly elliptic-oblanceolate, acute or obtuse. Lip 7–8 mm. long and about 3 mm. broad, lanceolate-obovate, unguiculate, 3-lobed, mid-nerve more or less lamellate and often dentate; mid-lobe subrotund; lateral lobes usually short, lanceolate to lanceolate-ovate.

Florida, Mexico, Panama and Cuba.

CANAL ZONE: Barro Colorado Island, *Kenoyer 250.*

This species has the appearance of a saprophyte but probably is not. It has been collected but once in Panama.

5. VANILLA Sw.

VANILLA Sw. in Nova Acta Soc. Sci. Upsal. 6:66. 1799; Rolfe in Jour. Linn. Soc. Bot. 32:439–478. 1896.

Usually epiphytic, scandent, leafy (in Panama) or leafless herbs, often with branched stems. Leaves coriaceous or fleshy, sessile or short-petiolate. Inflorescence a (short) raceme from the axils of the leaves. Sepals subequal, spreading, free. Petals similar to the sepals. Lip with its claw adnate to the column, often enfolding the column. Column elongated, footless, wingless; anther incumbent (rarely appearing erect); pollinia granular. Capsule ("bean") elongated, fleshy, often fragrant.

The only truly commercial members of the Orchidaceae belong to the genus *Vanilla.* The extract of the Vanilla "bean" was perhaps the first flavoring used by the American Indians. Natural Vanilla flavoring is now largely displaced by the synthetic.

The taxonomy of *Vanilla* is most difficult because of the fugaceous flowers.

a. Lip with verrucose lines or papillae.. 1. V. PLANIFOLIA
aa. Lip without verrucose lines or papillae.. 2. V. POMPONA

1. VANILLA PLANIFOLIA Andr. Bot. Repos. 8: *t. 538.* 1808; Dillon in Am. Orch. Soc. Bull. 10:339, *t. 11.* 1942.

Vanilla fragrans of authors.

Scandent branched leafy herbs. Leaves 8–23 cm. long and 2–8 cm. broad, narrowly lanceolate to elliptic-oblong, acute or acuminate, fleshy. Raceme short, 5–7 cm. long, axillary; bracts 5–10 mm. long, oblong, obtuse or subacute. Sepals 4–7 cm. long and 1–1.5 cm. broad, linear to oblanceolate, obtuse or acute. Petals similar to the sepals but smaller. Lip 4–5 cm. long and 1.5–3 cm. broad, with longitudinal, verrucose lines or papillae and a tuft of pubescence on the disc. Column about 3 cm. long, pubescent dorsally. Capsule ("bean") up to about 20 cm. long and 1 cm. in diameter.

Mexico to Panama, probably also in the West Indies. Cultivated throughout the tropics of the world.

SAN BLAS: Perme, *Cooper 287.* CANAL ZONE: Fort Clayton and Corozal, *Standley 29103.* PANAMÁ: Río Tecúmen, *Standley 29353;* near Panamá, *Standley 29731.*

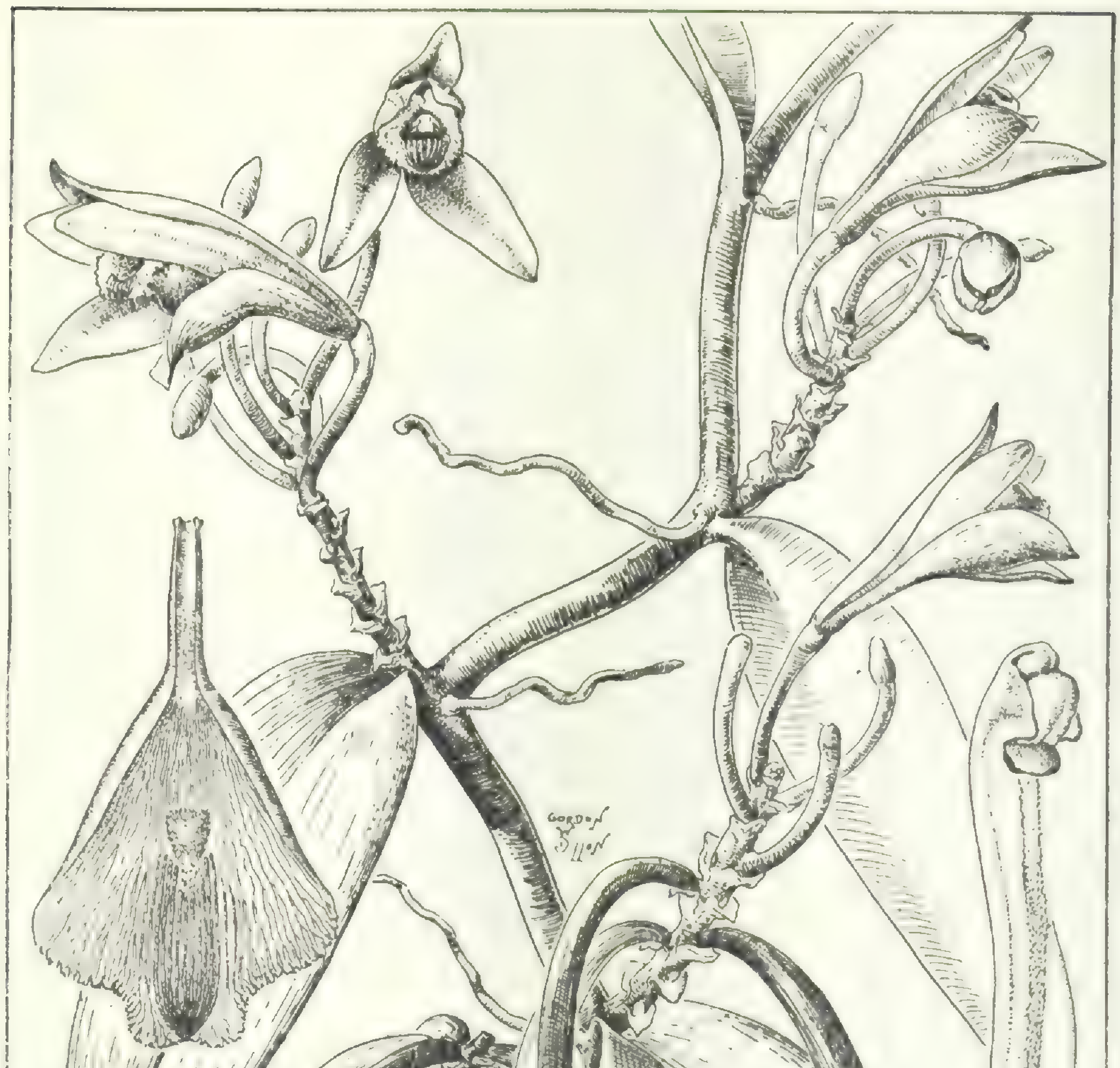

Fig. 68. *Vanilla planifolia*

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We think that *Vanilla rubra* (Lam.) Urban will probably prove to be the correct name for this species.

This is the most commonly cultivated of the Vanillas. There are apparently several forms of the species and considerable difference in the flavor of the Vanilla extract in the various forms.

2. Vanilla pompona Scheide in Linnaea 4:573. 1829; Ames, Sched. Orch. 9:6. 1925.

Vanilla Pompona Lindl. Gen. & Sp. Orch. Pl. 437. 1840.
Vanilla Pittieri Schltr. in Fedde Rep. Sp. Nov. 3:106. 1906.

Scandent, branched, leafy herbs. Leaves 10–30 cm. long and 3.5–9 cm. broad, variable in shape, narrowly elliptic-oblong or elliptic-lanceolate to lanceolate-ovate, rarely obovate-lanceolate, often oblique, acute or obtuse, coriaceous. Inflorescence up to about 16 cm. long, several-flowered, axillary; bracts about 1 cm. long, lanceolate to ovate, obtuse or acute, cucullate. Sepals 7–8.5 cm. long, linear-elliptic to narrowly oblanceolate, obtuse or acute. Petals similar to the sepals or a little smaller. Lip 7–8.5 cm. long and 2.5–4 cm. broad, obovate-lanceolate to obovate, unguiculate, crenulate at least toward the apex, with a tuft of hair in the center of the disc. Column up to about 6 cm. long. Capsule ("bean") about 15 cm. long, fusiform.

Mexico to Panama, the West Indies, Venezuela, Ecuador, Bolivia, British and Dutch Guiana; possibly as a cultigen in some of these countries and possibly elsewhere.

canal zone: *Hunter & Allen 852; Maxon 6779; Powell 127, 412, 3507; Piper.*

Vanilla Pompona is cultivated in some places. It is probably inferior to *V. planifolia* for making extract of Vanilla.

6. ELLEANTHUS Presl

Elleanthus Presl, Rel. Haenk. 1:97. 1827; Benth. & Hook. Gen. Pl. 3:522. 1883.

Evelyna Poepp. & Endl. Nov. Gen. & Sp. Pl. 1:32. 1835.

Terrestrial or epiphytic herbs ordinarily with strongly nerved, plicate, cauline leaves. Sepals subequal, free or the laterals somewhat connate at the base and forming a mentum. Petals subequal to the sepals, usually narrower. Lip adnate to the base of the column and usually enfolding it, subequal to or exceeding the sepals, usually gibbous-concave at the base and constricted above the base, the basal cavity containing two large, usually subovoid calluses. Column erect, footless; anther operculate, more or less incumbent or erect, bilocular; pollinia 8, subceraceous.

A rather natural genus which is highly developed in the Andes.

a. Inflorescence distichous.
  b. Stems fasciculately branched .... 4. E. aurantiacus
  bb. Stems not fasciculately branched.

c. Leaves 1.5 cm. or less long, oblong-lanceolate or broader, persistent.......7. E. MUSCICOLA
cc. Leaves 1.5 cm. or more long, elliptic-lanceolate or narrower, deciduous.
d. Bracts of the inflorescence imbricated; leaves subfiliform to linear.......6. E. LINIFOLIUS
dd. Bracts of the inflorescence not imbricated; leaves elliptic-lanceolate.......5. E. LAXUS
aa. Inflorescence not distichous.
b. Stems fasciculately branched.......4. E. AURANTIACUS
bb. Stems not fasciculately branched.
c. Inflorescence capitate or subcapitate.......1. E. CAPITATUS
cc. Inflorescence spicate or racemose.
d. Lip trilobulate.......3. E. TRILOBATUS
dd. Lip not trilobulate.......2. E. HYMENOPHORUS

1. ELLEANTHUS CAPITATUS (P. & E.) Reichb. f. in Walp. Ann. 6:475. 1862.

Evelyna capitata Poepp. & Endl. Nov. Gen. & Sp. Pl. 1:32. 1835.
Bletia capitata R. Br. in Ait. Hort. Kew. ed. 2, 5:206. 1813, *but not basis of Elleanthus capitatus.*

Epiphytic or terrestrial, reed-like herbs up to about 12 dm. tall. Stems slender, erect, covered with leaf-sheaths or naked below. Leaves 5–25 cm. long (mostly 15–20 cm.) and 1–5.5 cm. broad, linear-lanceolate to ovate-lanceolate, acuminate, plicate, reduced upward and becoming bract-like. Inflorescence a dense, many-flowered, capitate or subcapitate raceme; outer bracts sterile, triangular-ovate, acuminate, up to about 4 cm. long, inner bracts fertile, ovate-lanceolate, acute or acuminate, shorter than the outer bracts; flowers covered with a glutinous material. Dorsal sepal 8–12 mm. long and 2.5–4 mm. broad, oblong-lanceolate, acute, slightly cucullate. Lateral sepals 8–12 mm. long and 3–4 mm. broad, elliptic-oblong, acute, somewhat oblique. Petals 11–12 mm. long and 1–2 mm. broad, linear, obtuse or acute. Lip 8–13 mm. long and 8–11 mm. broad, oval to sub-orbicular-flabellate, anterior margins more or less lacerate-dentate, base gibbous and with two approximate, subglobose calluses; disc thickened in the middle.

Mexico to Panama, the West Indies and in South America to Peru.

CHIRIQUÍ: Monte Lirio, alt. 1300–1900 m., *Seibert 140, 268.*

A distinctive and widespread species. The name is based on *Evelyna capitata* Poepp. & Endl., and not on *Bletia capitata* R. Br., although the two names apparently represent the same species.

2. ELLEANTHUS HYMENOPHORUS Reichb. f. in Walp. Ann. 6:480. 1862.

Evelyna hymenophora Reichb. f. in Bot. Zeit. 10:710. 1852.

Caespitose, epiphytic herbs up to about 6.5 dm. tall (usually much less). Stems slender, covered with leaf-sheaths. Leaves 4–17 cm. long and 1.8–8 cm. broad, elliptic, elliptic-ovate, ovate or oval, acuminate, pergameneous. Inflorescence a compact many-flowered spike up to about 9 cm. long; bracts up to about 1.5 cm. long, lanceolate-ovate or ovate, acuminate. Dorsal sepal 5.5–7 mm. long and about 2.5 mm. broad, lanceolate to oval, acute. Lateral sepals 5–7 mm. long and 2–3 mm. broad, lanceolate to oblong-lanceolate, acute, strongly keeled dorsally.

Petals 3.5–7 mm. long and 1–1.5 mm. broad, linear-spatulate to spatulate, obtuse or acutish, more or less crenulate above. Lip 7–9 mm. long and 6.5–9 mm. broad, broadly ovate to orbicular, lacerate-dentate, the gibbous-saccate base enclosing 2 ovoid calluses and the sac with a bidentate lamellate callus in front.

Costa Rica, Panama, Colombia and Peru.

CHIRIQUÍ: "Chiriquí," *Warscewicz.* COCLÉ: summit of Valle Chiquita, alt. 1360 m., *Bouché 3X;* hills north of El Valle de Antón, alt. 1000 m., *Allen 2172;* near Cerro Turega, alt. 650–700 m., *Woodson & Schery 168.* PANAMÁ: hills above Campana, alt. 600–800 m., *Allen 1883.*

3. ELLEANTHUS TRILOBATUS Ames & Schweinf. Sched. Orch. 8:53. 1925.

Slender epiphytic herbs up to about 8 dm. tall. Leaves 5–18 cm. long and 0.5–2.5 cm. broad, linear-lanceolate to lanceolate, acuminate, plicate, apex trilobulate, reduced upwards, basal part of the stem in mature plants naked. Inflorescence up to 8 cm. long, many-flowered; bracts up to 2.5 cm. long, ovate-lanceolate to ovate, acuminate, cucullate, chartaceous, reduced upward. Sepals more or less pubescent dorsally. Dorsal sepal 6–8 mm. long and 2–3.5 mm. broad, oblong-lanceolate to narrowly ovate-lanceolate, acute, apiculate. Lateral sepals 6–8 mm. long and 2.5–3 mm. broad, ovate-lanceolate to oblong-lanceolate, somewhat oblique, acute, cucullate. Petals 5–7 mm. long and 1–1.5 mm. broad, linear-oblong, obtuse. Lip trilobulate, 6–7.5 mm. broad, obovate-orbicular, flabellate, fimbriate-lacerate on the terminal half, base gibbous-saccate and with 2 oval calluses, disc with 2 transverse, sublamellate calluses about opposite each sinus. Ovary puberulent.

Costa Rica, Panama and Colombia.

COLÓN: near Porto Bello, *Maxon 5808.* PANAMÁ: vicinity of Campana, alt. about 1000 m., *Allen 2405;* hills east of [Panama] City or San Juan, *Powell 97, 3266, 3267, 3268, 3273, 3529.* CANAL ZONE: Barro Colorado Island, *Shattuck 201.*

The Powell specimens, regardless of numbers, are probably all from one collection. Schlechter has determined *Maxon 5808* and *Powell 97* as his *Elleanthus Brenesii* and says of the latter collection (Fedde, Rep. Sp. Nov. Beih. 17:13. 1922): "Die Pflanze stimmt recht gut mit meinem Originalexemplar aus Costa Rica überein." The description and analysis of *E. Brenesii* are not entirely satisfactory but when the type can be studied *E. trilobatus* will probably prove to be a synonym.

4. ELLEANTHUS AURANTIACUS (Lindl.) Reichb. f. in Walp. Ann. 6:482. 1863.

Evelyna aurantiaca Lindl. in Benth. Pl. Hartw. 149. 1844.
Elleanthus Tonduzii Schltr. in Fedde Rep. Sp. Nov. 8:567. 1910.

Erect or ascending, branched or usually fasciculately branched herbs up to about 1 m. or more tall. Stems slender, covered with sheaths but becoming naked below, the lateral stems usually smaller than the main stem. Leaves 2–12 cm. long and 0.2–1.4 cm. broad, linear-lanceolate to lanceolate, acuminate, apex 2–3-lobulate and short-aristate, plicate. Inflorescence up to about 4 cm. long, bilateral;

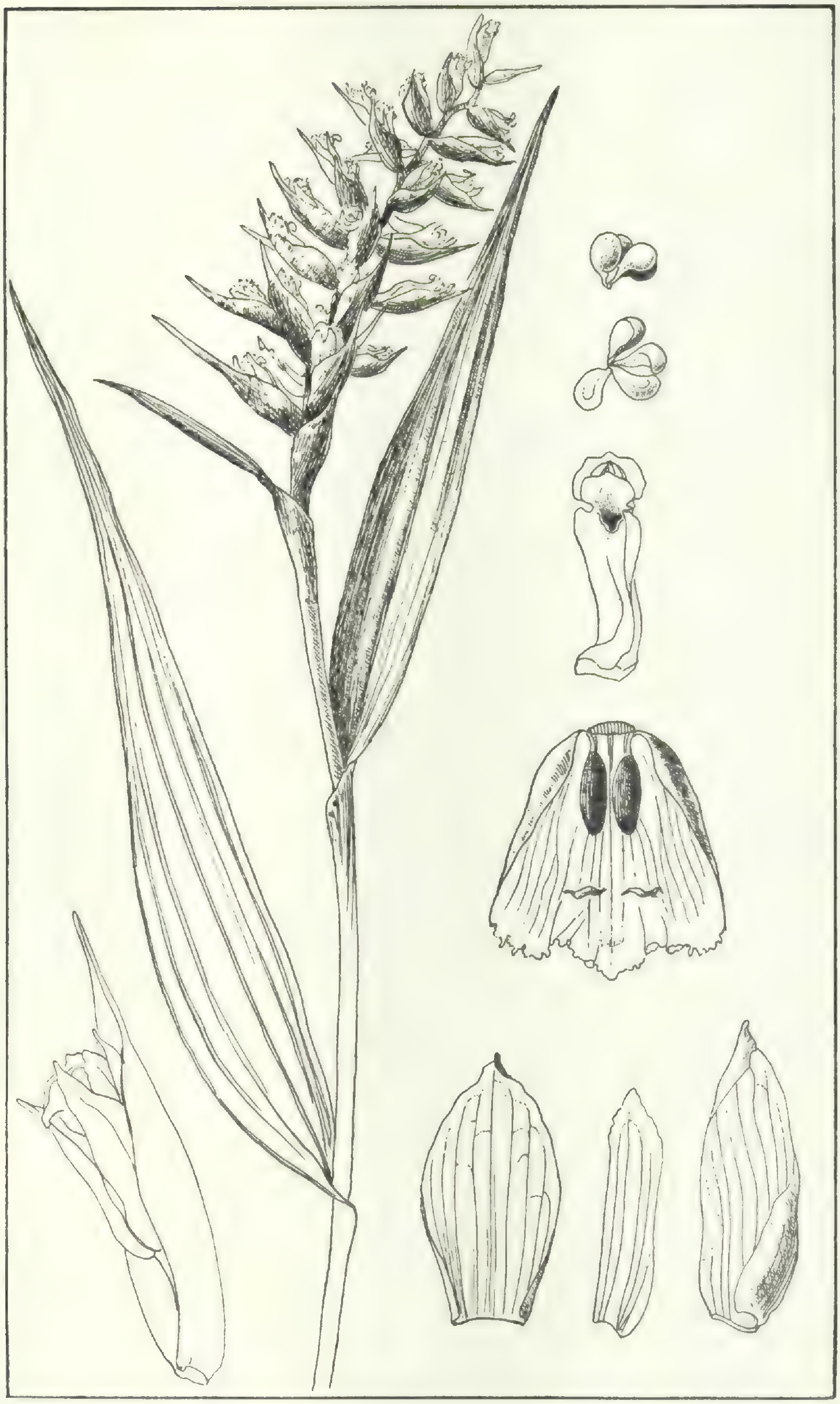


Fig. 69. *Elleanthus trilobatus*

bracts up to about 1.5 cm. long, ovate-lanceolate or ovate, acuminate, cucullate, scarious; rachis somewhat fractiflex. Sepals often puberulous dorsally. Dorsal sepal 4.5–7 mm. long and 2–3.5 mm. broad, lanceolate to ovate-lanceolate, acute, cucullate. Lateral sepals 6–8 mm. long and 3–4 mm. broad, lanceolate to lanceolate-triangular, acute, somewhat arcuate. Petals 5–8 mm. long and 2–2.5 mm. broad, linear-oblong or oblanceolate, obtuse or acute, often somewhat undulate. Lip 7–10 mm. long and 7–9 mm. broad, obovate-flabellate to suborbicular, lacerate-dentate at least toward the apex, saccate-gibbous at the base and with 2 approximate calluses.

Costa Rica, Panama, and in South America to Peru.

CHIRIQUÍ: Bajo Chorro, alt. 2100 m., *Davidson 123*. PANAMÁ: hills above Campana, July 1, 1939, *Allen 1884*.

Elleanthus aurantiacus is a widespread species with a distinctive mode of branching. The description is based on the Central American material and typical material from South America. Some specimens from South America are much more robust and have larger leaves than typical.

5. ELLEANTHUS LAXUS Schltr. in Fedde Rep. Sp. Nov. 12:213. 1913; in Fedde Rep. Sp. Nov. Beih. 59: *t. 4, fig. 16.* 1931.

Slender erect caespitose herbs up to about 4 dm. tall. Leaves 4–12 cm. long and 0.4–1.2 cm. broad, elliptic-lanceolate, acuminate, 2–3-dentate at the apex, plicate, mostly near the summit of the stems. Inflorescence up to 5 cm. long, few–several-flowered, distichous, strongly fractiflex; bracts up to 4.5 cm. long, reduced upward, lanceolate to ovate-lanceolate, acuminate, chartaceous, strongly cucullate, longer than the flowers. Sepals ligulate, acuminate, 7 mm. long, the laterals oblique. Petals oblique, linear, subacute, about equal to the sepals. Lip concave-subcucullate at the base, dilated above and deeply emarginate, the margins crenate-incised and undulate, 6 mm. long and 4 mm. broad above the middle, base with 2 oblong calluses, the disc with a few papillae.

Costa Rica (?) and Panama.

DARIÉN: Sambú Basin, alt. 500–974 m., *Pittier 5640*.

The description of the flowers is taken from the original publication. No flowers from typical material have been seen but there is an analysis (by Schlechter) in the Ames Herbarium. If the analysis is correct the Costa Rican material, of which flowers are available, belongs to a different species. The Costa Rican material called *E. laxus* has a lip which is essentially oblong, emarginate, lacks surface papillae of any sort (certainly lacks the tooth-like "papillae" of Schlechter's analysis and the figure cited); the petals are differently shaped as are the lateral sepals.

6. ELLEANTHUS LINIFOLIUS Presl, Rel. Haenk. 1:97. 1827.

Isochilus linifolium Lindl. Gen. & Sp. Orch. Pl. 113. 1831.

Densely caespitose epiphytic herbs up to about 3.5 dm. tall, but mostly up to

about 1.5 dm. tall in Panama. Stems slender, covered with the leaf-sheaths or partially naked. Leaves 1.5–9 cm. long and 0.1–0.4 cm. broad, subfiliform to linear, acute, obtuse or denticulate at the apex. Inflorescence up to 2.5 cm. long, a short, distichous, obscurely fractiflex raceme; bracts up to about 1.5 cm. long, lanceolate or ovate-lanceolate, acute or acuminate, cucullate, scarious, imbricated. Sepals glabrous or sparsely brown-pubescent dorsally. Dorsal sepal about 3 mm. long and 1 mm. broad, elliptic-lanceolate, cucullate. Lateral sepals 3–3.5 mm. long and 1.2–1.5 mm. broad, ovate-lanceolate, short-acuminate, somewhat arcuate. Petals about 3 mm. long and 1–1.2 mm. broad, linear-oblong to oblong-spatulate, obtuse, truncate, obscurely crenulate, arcuate. Lip about 3–3.5 mm. long and 4–5 mm. broad, subquadrate-flabellate to flabellate, truncate, denticulate, gibbous at the base and with 2 lightly attached ovoid calluses, with a short transverse callus above the base.

Mexico, British Honduras, Guatemala, Costa Rica, Panama, the West Indies and south to Peru.

COLÓN: Cativa-Porto Bello trail, *Powell 353*. COCLÉ: El Valle de Antón, alt. 600 m., *Allen 2075*; hills north of El Valle de Antón, alt. 1000 m., *Allen 2869*. CANAL ZONE: Gatún Lake, *Purdom*.

7. ELLEANTHUS MUSCICOLA Schltr. in Fedde Rep. Sp. Nov. Beih. 19:10. 1923.

Small caespitose epiphytic herbs up to about 12 cm. tall. Stems slender, covered with leaf-sheaths. Leaves 10–15 mm. long and 2.5–5 mm. broad, oblong-lanceolate to oblong-ovate, obtuse, coriaceous, persistent, distichous. Inflorescence up to about 1.7 cm. long, a short distichous, obscurely fractiflex raceme; bracts up to about 1 cm. long, lanceolate-ovate or ovate, compressed, cucullate, scarious, sphacelate, imbricated. Sepals substellate-furfuraceous dorsally; dorsal sepal about 3 mm. long and 1 mm. broad, elliptic, acute, cucullate; lateral sepals about 3 mm. long and 1.5 mm. broad, ovate-lanceolate, acuminate, cucullate. Petals about 3.5 mm. long and 1.5 mm. broad, oblanceolate-subflabellate, obtuse, crenulate-undulate above. Lip about 3–3.5 mm. long and 3.5–4 mm. broad, flabellate-triangular, truncate and denticulate.

Costa Rica and Panama.

COCLÉ: hills north of El Valle de Antón, alt. 1000 m., *Allen 2159*.

Elleanthus muscicola is unusual in the genus because of the habit and small persistent leaves.

7. SOBRALIA Ruiz & Pavon

SOBRALIA Ruiz & Pavon, Fl. Peruv. & Chil. Prodr. 120, *t. 26*. 1794.

Fregea Reichb. f. in Bot. Zeit. 10:712. 1852.
Lindsayella Ames & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 5:33. 1935.

Large or small, reed-like, terrestrial or epiphytic herbs. Leaves pergameneous, plicate-veined, sessile, usually few. Inflorescence a terminal raceme or often reduced to 1 flower; flowers fugaceous in Panamanian species. Sepals equal or nearly so, erect or somewhat spreading, connate at their bases. Petals similar to the sepals

but usually broader. Lip erect, from the base of the column, usually covering or enfolding the column, simple, retuse or 3-lobed, usually concave, a little longer than the sepals and petals, often undulate or fimbriate; the disc smooth, lamellate or lamellate-cristate, usually with inconspicuous or conspicuous callus thickenings at the base. Column elongated, semi-terete, more or less arcuate, with narrow wings (auricles) or acute angles at the apex, footless; anther incumbent; pollinia 8, granular or subceraceous.

A small tropical American genus, possibly with its center of distribution in Panama. Difficult to work because of the fugaceous flowers.

Fregea, a genus described by Reichenbach, has been maintained as distinct but has no characters which will separate it from *Sobralia.*—The original specimen was collected in Chiriquí.

Lindsayella, a genus based on specimens from Panama, seems to have no characters of generic value. The main segregation character is the callus at the base of the lip. Rather than a generic character these calluses seem to be the culmination of a tendency within the genus *Sobralia.*

Our knowledge of this genus in Panama is entirely inadequate. A large number of the species presumed to grow there were described by Reichenbach from material collected by Warscewicz, and of many of them nothing further is known. Paul H. Allen, long a resident of Panama and the keenest collector of orchids who has been in the country, is inclined to believe that many of the Warscewicz Sobralias which were ascribed to Panama were actually collected elsewhere. Mr. Allen writes that when Sobralias are present in the Panama flora they are apt to be quite abundant; yet he has not been able to discover many of the species that Warscewicz is said to have collected in Chiriquí Province although he has collected the same area many times.

We have not been able to make a satisfactory key to this genus because many of the species are practically unknown and require more study, as a whole, than is possible now.

1. Sobralia Allenii L. Wms. in Ann. Missouri Bot. Gard. 29:336, *pl. 30, figs. 1–3.* 1942.

Caespitose, epiphytic plants up to about 5 dm. tall. Stems about 1–2 mm. in diameter, slender, bearing 1–3 leaves toward the apex, leafless below or the leaves reduced to sheaths. Leaves 13–18.5 cm. long and 1.8–2.5 cm. broad, elliptic-lanceolate to narrowly elliptic, acuminate, plicate, with seven principal nerves, lepidote on the lower surface especially along the nerves at the base, glabrous above or essentially so; leaf-sheaths closely appressed to the stem, lepidote. Inflorescence terminal, 1-flowered; flowers small, white with a pale yellow lip. Dorsal sepal about 3.5 cm. long and 7 mm. broad, oblanceolate, apiculate, 7-nerved. Lateral sepals about 3.5 cm. long and 7 mm. broad, linear-oblong, apiculate, 7-nerved. Petals about 3.5 cm. long and 6–7 mm. broad, oblanceolate, acute, terminal half serrulate, 7-nerved. Lip about 3.5 cm. long and 1.8 cm. broad, oblong-oval, truncate or shallowly retuse, terminal half lacerate-dentate; disc with several

Fig. 70. *Sobralia Allenii*

inconspicuous longitudinal carinae and with a small bipartite callus thickening at the base, pubescent longitudinally along the middle, especially toward the apex.

Panama.

COCLÉ: hills north of El Valle de Antón, alt. 1000 m., *Allen 2686.*

2. SOBRALIA **amabilis** (Reichb. f.) L. Wms., comb. nov.

Fregea amabilis Reichb. f. in Bot. Zeit. 10:712. 1852; Beitr. Orch. Centr.-Am. 10, *t. 2.* 1866.

Epiphytic or terrestrial herbs up to 6 dm. tall. Leaves 3–10.5 cm. long and 1–3.5 cm. broad, elliptic to broadly lanceolate-elliptic, acuminate; leaf-sheaths prominently verrucose. Inflorescence a single terminal flower; flower small for the genus, purple. Sepals 23–27 mm. long and 7–8 mm. broad, elliptic to elliptic-oblanceolate, acute, apiculate. Petals 20–25 mm. long and 8–10 mm. broad, broadly elliptic to elliptic-obovate, obtuse or acute. Lip 30–35 mm. long and 20–25 mm. broad, quadrate-obovate, emarginate, somewhat narrowed at the base and enfolding the column; column 10–15 mm. long.

Costa Rica and Panama.

CHIRIQUÍ: An einer nassen und kalten Stelle, Cordilleren von Chiriquí, *Warscewicz.*

The original species of the genus *Fregea,* which we do not consider distinct from *Sobralia.*

3. SOBRALIA BLETIAE Reichb. f. in Bot. Zeit. 10:713. 1852.

Plants of unknown but probably large size. Leaves 10–17 cm. long and 3–4.5 cm. broad, elliptic to broadly lanceolate, acute. Lip about 4 cm. long and about 2 cm. broad, cuneate or narrowly obovate in outline, 3-lobed; lateral lobes lanceolate-triangular, falcate; mid-lobe obovate-orbicular, emarginate, slightly exceeding the lateral lobes; disc with five crisped lamellae.

Panama.

CHIRIQUÍ: *Warscewicz.*

We have seen no material of this species. The description is taken from the original and from a photograph of the very poor type specimen.

4. SOBRALIA BOUCHEI Ames & Schweinf., Sched. Orch. 10:4. 1930.

Slender terrestrial or epiphytic herbs up to 7.5 dm. tall. Stems about 3–4 mm. in diameter. Leaves 8–17 cm. long and 3–4.5 mm. broad, elliptic or broadly elliptic-lanceolate, acute, marginate. Sepals 5.5–6.5 cm. long and 1.5–1.7 cm. broad, elliptic to lanceolate, the laterals somewhat arcuate. Petals about 6 cm. long and 2.2 cm. broad, elliptic-oblanceolate, acute, somewhat oblique. Lip about 5.5 cm. long and 5 cm. broad, obovate-orbicular, trilobulate, margins crenulate-dentate anteriorally; mid-lobe small, suborbicular; disc with 7 longitudinal, crispate carinae. Column about 2.5 cm. long.

Panama.

COCLÉ: El Valle de Antón, alt. about 1000 m., *Allen 2454.* "PANAMÁ": *Bouché s. n.*

Probably the original came from Coclé or Chiriquí. It is very closely allied to *S. Bletiae* Reichb. f.

5. SOBRALIA **callosa** L. Wms., nom. nov.

Lindsayella amabilis Ames & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 5:33. 1937, non *Sobralia amabilis* (Reichb. f.) L. Wms.

Slender, caespitose (?), epiphytic or terrestrial herbs up to about 4 dm. tall. Leaves 4.5–10.5 cm. long and 3–8 mm. broad, narrowly elliptic to linear-lanceolate, acute or obtuse, apex 2–3-dentate, prominently plicate; leaf-sheaths concealing the stems, striate, glabrous. Inflorescence usually 1-flowered, from the axis of the uppermost leaf. Sepals 20–25 mm. long and 7–8 mm. broad, elliptic, acute, the laterals slightly arcuate, slightly connate at the base. Petals 2, 20–23 mm. long and 10–12 mm. broad, lanceolate to lanceolate-ovate, acute. Lip about 30 mm. long and about 20 mm. broad toward the apex, triangular-obovate in outline, emarginate, somewhat crenate, the lamina with 1 prominent, crispate lamella and with a prominent oblong-obovoid callus at the base. Column about 10–12 mm. long.

Panama.

COCLÉ: a specimen originally collected in Coclé, cultivated in the Canal Zone Experiment Gardens, *Lindsay 449*.

6. SOBRALIA FENZLIANA Reichb. f. in Bot. Zeit. 10:714. 1852.

Slender terrestrial or epiphytic herbs. Leaves 13–17 cm. long and 4–6 cm. broad, elliptic-oblong to lanceolate-ovate, acuminate. Sepals about 4 cm. long, elliptic or oblong-elliptic, acute. Petals a little shorter than the sepals, narrowly obovate, acute. Lip (4–6 cm. long?) obovate-orbicular, crenate-dentate anteriorally, ecarinate.

Panama.

CHIRIQUÍ: *Warscewicz 48*.

The description is taken from the original and an analysis of the type. Seems to differ from S. *Bouchei* only in lacking carinae on the lip.

7. SOBRALIA FRAGRANS Lindl. in Gard. Chron. 598. 1853.

Sobralia eublepharis Reichb. f. ex Kränzl. in Fedde Rep. Sp. Nov. 26:255, *t. 78*. 1929.

Relatively small, terrestrial or epiphytic herbs up to 35 cm. tall. Stems ancipitous, with the principal leaf near the middle. Leaves 6.5–23.5 cm. long and 1.5–5 cm. broad, narrowly elliptic to broadly lanceolate, acute or acuminate. Sepals 3–4 cm. long and 0.4–0.7 cm. broad, linear to oblong-lanceolate, acute or apiculate, the laterals somewhat falcate. Petals 3–4 cm. long and about 0.5 cm. broad, lanceolate to oblanceolate-linear, obtuse or acute, sometimes apiculate. Lip 28–35 mm. long and 16–20 mm. broad, oval to obovate, the anterior margin dentate-fimbriate, the posterior margins entire; disc with several thickened nerves and 2 callus thickenings at the base, pubescent especially toward the apex. Column about 16–18 mm. long.

British Honduras, Guatemala, Honduras, Costa Rica and Panama.

CHIRIQUÍ: San Felix to Cerro Flor, alt. 100–800 m., *Allen 1941*. VERAGUAS: headwaters of Río Cañazas, alt. 300–600 m., *Allen 167*. COCLÉ: between Las Margaritas and

El Valle, *Woodson, Allen & Seibert 1314.* PANAMÁ: drowned forest near Vigia and San Juan, *Dodge, Steyermark & Allen 16521.* CANAL ZONE: *Powell 114, 3404, 3424.*

Perhaps the most distinctive of the Panamanian species of the genus.

8. SOBRALIA LABIATA Warsz. & Reichb. f. in Bot. Zeit. 10:714. 1852.

A plant of unknown size. Leaves up to about 27 cm. long and 2 cm. broad, linear-lanceolate, acuminate. Sepals about 6 cm. long, oblong-lanceolate, acute. Petals about as long as the sepals and a little broader. Lip about 7–8 cm. long and 5–6 cm. broad, flabellate, anteriorly crenulate, retuse.

Panama.

CHIRIQUÍ: *Warscewicz.*

The description is taken from the original and a poor analysis of the type.

9. SOBRALIA LEUCOXANTHA Reichb. f. Beitr. Orch. Centr.-Am. 68. 1866; Hook. f. in Bot. Mag. 115: *t. 7058.* 1889.

Sobralia Powellii Schltr. in Fedde Rep. Sp. Nov. Beih. 17:11. 1922.

Tall, slender, terrestrial or epiphytic herbs up to 1.5 m. tall. Leaves 8–22 cm. long and 3–7 cm. broad, elliptic to lanceolate, acuminate, glabrous above, more or less scurfy below; leaf-sheaths verruculose or obscurely punctate. Inflorescence 1-flowered; the flowers large. Sepals and petals white, the lip white with the throat yellow to orange. Sepals 5–8.5 cm. long and 1.5–2.5 cm. broad, linear-lanceolate to oblong. Petals 5–7 cm. long and 2.5–3.5 cm. broad, oblong to obovate. Lip 5–7 cm. long and up to 5 cm. broad, obovate, enfolding the column, somewhat retuse, margin undulate, with short calluses at the base and 1–3 thickened nerves above. Column 3–4.6 cm. long.

Costa Rica and Panama.

COCLÉ: south of El Valle, alt. 600 m., *Allen 2839, 2840;* mountains beyond La Pintada, alt. 400–600 m., *Hunter & Allen 620.* PANAMÁ: Peluca Hydrographic Station, alt. about 90 m., *Hunter & Allen 648;* Gatún Lake, *Powell 2, 3329, 3330, 3331.*

There seems to be little or no difference between *Sobralia leucoxantha* and *S. Powellii.*

10. SOBRALIA LINDLEYANA Reichb. f. in Bot. Zeit. 10:713. 1852; Xenia Orch. 2:156, *t. 163.* 1868.

Slender epiphytic or terrestrial herbs up to 6 dm. tall. Leaves 5.5–13 cm. long and 2–5 cm. broad, elliptic-lanceolate to ovate-lanceolate, acuminate, often vernicose above; sheaths neither pubescent nor verruculose. Inflorescence 1-flowered; the flowers white or (with age?) yellowish, the lip with red maculations. Sepals 4–5 cm. long and 0.8–1.2 cm. broad, elliptic-lanceolate to elliptic-oblong, acute. Petals 3.5–4.5 cm. long and 1.2–1.4 cm. broad, similar to the sepals or broader. Lip 4–5 cm. long and 3–4 cm. broad, cuneate-flabellate or obovate, subtrilobate, the lobes rounded, apical part of the lip dentate-lacerate or crisped; disc with a tricornute callus at the base and pubescent longitudinally within. Column about 2 cm. long, with 2 acinaciform, terminal stelidia or auricles.

Fig. 71. *Sobralia panamensis*

Costa Rica and Panama.

CHIRIQUÍ: Llanos del Volcán, alt. 1120–1200 m., *Seibert 325;* Chiriquí Viejo Valley, *White 83;* "Chiriquí," *Warscewicz.*

11. SOBRALIA PANAMENSIS Schltr. in Fedde Rep. Sp. Nov. Beih. 17:11. 1922.

Sobralia panamensis var. *albiflos* Schltr. loc. cit.

Erect or ascending, epiphytic or terrestrial herbs; the stems up to about 15 dm. long, simple, branching or producing new plants at the nodes, lepidote or furfurescent. Leaves 5–20 cm. long and 2–6.5 cm. broad, elliptic to broadly elliptic-lanceolate, acuminate, glabrous or slightly furfurescent at the base dorsally; leaf-sheaths densely pubescent, lepidote or furfurescent, older sheaths appearing pustulate. Flowers purple to white. Sepals 4.5–6 cm. long and about 1.2–1.6 cm. broad, ligulate to lanceolate, acute, the laterals somewhat oblique. Petals a little shorter than the sepals and up to about 2 cm. broad, obtuse or acute. Lip 4–6 cm. long and 3–4 cm. broad, obovate or oblong-obovate, obtuse, glabrous, apex undulate, with 2 small calluses at the base. Column up to about 3 cm. long.

Panama.

COCLÉ: mountains beyond La Pintada, alt. 400–600 m., *Hunter & Allen 664.* PANAMÁ: Taboga Island, *Allen 106;* Bejuco, *Allen 2669;* Hacienda La Joya, *Dodge et al. 106c.* CANAL ZONE: Santa Rita Trail, *Cowell 146;* Quebrada Ancha, *Dodge & Steyermark 106a, 106b;* near Vigía and San Juan, *Dodge et al. 16557;* hills east of canal, *Powell 21, 31, 3082, 3086, 3105;* Barro Colorado Island, *Woodworth & Vestal 388.*

Sobralia panamensis is closely allied to S. *decora* Batem. and to S. *sessilis* Lindl. but seems to be distinct.

12. SOBRALIA DECORA Batem. var. AERATA Allen & Williams in Ann. Missouri Bot. Gard. 29:337, *t. 31.* 1942.

Slender, erect, epiphytic or terrestrial herbs up to about 5 or 6 dm. tall. Stems covered with the amplexicaul leaf-sheaths, simple or rarely branched. Leaves 8–16 cm. long and 1.3–5 cm. broad, lanceolate or lanceolate-ovate, acuminate, coriaceous. Inflorescence sessile, 1-flowered. Sepals 5.2–5.5 cm. long and 1.2–1.5 cm. broad, lanceolate, acute, greenish on the outer surface, very near "brick red" on the inner surfaces. Petals about 4.7 cm. long and 1–1.2 cm. broad, elliptic-lanceolate, acute, reflexed, washed "brick red" with lighter margins and dorsal median line, the inner surface "brick red" with a white border. Lip about 4 cm. long, more or less tubular but flaring at the apex, the disc "brick red" with a median white stripe and the lateral margins white toward the base, base of the lip "Acajou red" within.—Description from the type specimen and ample field notes.

The species is found from Mexico to Honduras. The variety only in Panama.

COCLÉ: bad lands south of El Valle de Antón, alt. 500–600 m., *Allen 2755, 2846.*

13. SOBRALIA ROLFEANA Schltr. in Fedde Rep. Sp. Nov. Beih. 17:12. 1922.

Erect, slender, probably terrestrial herbs up to about 1 m. tall. Leaves 6.5–21 cm. long and 2–7.5 cm. broad, oblong-elliptic to elliptic-oblanceolate or elliptic-lanceolate, acute to acuminate, glabrous and smooth, mostly near the

Fig. 72. *Sobralia decora* var. *aerata*

middle of the stem and above, reduced upward. Inflorescence probably consisting of a single flower in the axis of an upper leaf; flowers creamy-yellow with a lemon-yellow throat. Sepals 5.5–7.5 cm. long and 0.8–1.6 cm. broad, ligulate to elliptic or elliptic-lanceolate, acute, the laterals somewhat oblique. Petals 5.5–6.5

cm. long and 0.8–1.4 cm. broad, ligulate to oblong-ligulate, obtuse or acute. Lip 5.5–7 cm. long and 2.5–4.7 cm. broad, obovate, retuse, anterior margin lacerate-dentate, obscurely bilamellate at the base, glabrous. Column 2–3 cm. long, enfolding the lip.

Panama.

PANAMÁ: Cerro Campana, alt. 800 m., *Allen 2663*. CANAL ZONE: without definite locality, *Powell 3, 3327, 3357, 3358, 3374*. BOCAS DEL TORO: epiphyte with yellow flowers, *von Wedel 409*.

Sobralia Rolfeana is very closely allied to *S. leucoxantha* Reichb. f. and to *S. Lindleyana* Reichb. f.

14. SOBRALIA SUAVEOLENS Reichb. f. in Gard. Chron. n. s. 9:622. 1878.

Sobralia epiphytica Schltr. in Fedde Rep. Sp. Nov. 12:213. 1913.

Fig. 73. *Sobralia suaveolens*

Strict terrestrial or epiphytic herbs up to about 4 dm. tall. Leaves 5–19 cm. long and 2–4.5 cm. broad, elliptic to elliptic-lanceolate, acute; leaf-sheaths glabrous, not verrucose. Inflorescence usually 2–3-flowered, from the axils of the uppermost leaf; flowers small for the genus, yellow. Sepals and petals 20–25 mm. long and 4–5 mm. broad, linear-lanceolate, acute. Lip 20–25 mm. long and about 10–15 mm. broad, oval to ovate in outline, trilobulate toward the apex, with several (about 7) longitudinal lamellae which become lacerated toward the apex and are branched into two groups at the base; mid-lobe about 8 mm. long and broad, subquadrate. Column about 12 mm. long.

Panama.

PANAMÁ: Río La Maestra, alt. 0–25 m., *Allen 59*. CANAL ZONE: near Vígia and San Juan on R. Pequení, alt. 66 m., *Dodge et al. 16623*; Río Indio de Gatún, alt. sea-level, *Maxon 4829*; around Culebra, alt. 50–150 m., *Pittier 4780*.

The type was a specimen collected near Colón and grown in England.

15. SOBRALIA VALIDA Rolfe in Kew Bull. 1909:65. 1909.

Stems robust, glabrous, 20–25 cm. tall, 3–4-leaved, base covered with 2 tubular sheaths. Leaves broadly elliptic, subacute, subplicate, glabrous, subcoriaceous, 12–20 cm. long, 6–8.5 cm. broad, amplexicaul; sheaths tubular, subcompressed, ancipitous, 3–5 cm. long. Spathe abbreviated, subfoliaceous, apex subacute.

Bracts small. Flowers few, appearing at intervals, ochroleucous, fragrant. Pedicels short, subincluded. Sepals subconnivent, lanceolate-oblong, acute, equal, more or less concave. Lip entire, oblong, obtuse, minutely crenulate, concave, about 4 cm. long; disc tricarinate, veins pilose at the apex. Column clavate, 2 cm. long; teeth linear-oblong, incurved, about 4 mm. long.

Panama.

DARIÉN: near the Darién Gold Fields, *Dr. Hodgkinson.*

No specimens were seen. The description is taken from the original Latin.

16. SOBRALIA WARSZEWICZII Reichb. f. in Bot. Zeit. 10:714. 1852; Beitr. Orch. Centr.-Am. 9, *t. 1, figs. I, 1-2.* 1866.

Terrestrial herbs of unknown height. Stems robust, the younger ones hispidulous-pubescent, becoming glabrous and more or less verrucose with age. Leaves 13–18 cm. long and 4–6 cm. broad, elliptic-oval, acute or acuminate. Inflorescence a single terminal or subterminal flower; flowers average for the genus, purple. Sepals up to about 5 cm. long and 2 cm. broad, broadly oblanceolate. Petals about as long as and broader than the sepals, cuneate-obovate, acute. Lip about 5 cm. long and 3 cm. broad, flabellate, emarginate, apical part crisped, with 2 basal lamellae, somewhat verrucose at the base. Column 2–3 cm. long.

Panama.

CHIRIQUÍ: "Vulcanes von Chiriquí," alt. 1850 m., *Warscewicz 8.*

We have seen only a photograph and a record of the type.

OBSCURE SPECIES

SOBRALIA MACROPHYLLA Reichb. f. in Bot. Zeit. 10:713. 1852; Xenia Orch. 1:218, *t. 90.* 1856.

The type of this species is apparently a sterile specimen which was accompanied by the collector's sketch and color notes. Reichenbach later published a plate of the species and at the same time reduced the Brazilian *S. chlorantha* Hook. to synonymy. Inasmuch as the type is not satisfactory for diagnosis in this difficult genus we think it best to place *S. macrophylla* among the obscure species. It is possible that it and *S. Rolfeana* Schltr. are the same.

8. PALMORCHIS Barb. Rodr.

PALMORCHIS Barb. Rodr. Gen. & Sp. Orch. Nov. 1:169. 1877; Schweinf. & Correll in Bot. Mus. Leafl. Harv. Univ. 8:109. 1940.

Jenmania Rolfe in Kew Bull. 198. 1898, non Wächter, 1897.
Rolfea Zahlbr. in Jour. Bot. 36:493. 1898.
Neobartlettia Schltr. in Fedde Rep. Sp. Nov. 16:440. 1920.

Large or small, terrestrial, reed-like herbs. Leaves pergameneous, plicate-veined, petiolate, usually few. Inflorescence a terminal or axillary raceme or

panicle. Sepals equal or nearly so, connivent or somewhat spreading. Petals similar to the sepals but narrower and shorter. Lip erect from the base of the column and adnate with it toward the base along the median line, broader than the sepals and petals, enfolding the column, retuse or 3-lobed; the disc pubescent or glabrous, callused. Column elongated, slender, more or less arcuate, footless; anther incumbent, operculate, the terminal part fleshy and sterile; pollinia 4, pyriform, granular or subceraceous.

A small genus allied to *Sobralia*. There are eight or nine species with the center of distribution in northern South America. Specimens have not been often collected.

a. Disc of the lip without parallel lamellae; flowers about 13 mm. long.... 1. P. TRILOBULATA
aa. Disc of the lip with 5 parallel lamellae; flowers about 17 mm. long...... 2. P. POWELLII

1. PALMORCHIS TRILOBULATA L. Wms. in Ann. Missouri Bot. Gard. 28:415, *t. 20.* 1941.

Caespitose, terrestrial herbs up to 35 cm. tall. Stems up to about 15 cm. long and 4 mm. in diameter, bearing 3–4 leaves near the apex. Leaves subchartaceous, plicate; lamina of the mature leaves 10–22 cm. long and 3–6 cm. broad, elliptic, acute or acuminate, with 7 prominent nerves; petiole up to 7 cm. long, plicate, nervose. Inflorescence up to 7 cm. long, terminal, much exceeded by the leaves, few-flowered; rachis about 3–4 cm. long; bracts 1–1.5 cm. long and 1.5–5 mm. broad, elliptic to lanceolate-ovate, acute or acuminate. Flowers about 13 mm. long, white. Dorsal sepal about 12 mm. long and 3 mm. broad, spatulate-oblanceolate, obtuse, 3–5-nerved. Lateral sepals 10–12 mm. long and 3–4 mm. broad, arcuate, spatulate-oblanceolate, obtuse, 3–5-nerved, somewhat carinate along the mid-nerve dorsally. Petals 11–12 mm. long and about 2 mm. broad, linear-oblanceolate, obtuse, somewhat arcuate, 3-nerved. Lip about 10–12 mm. long and about 5–6 mm. broad near the apex, oblanceolate-flabellate, trilobulate at the apex, the base or claw adnate to the column along its median line for about 2–3 mm., more or less enfolding the column; disc of the lip pubescent, especially so toward the base, less pubescent and fleshy-thickened toward the apex; lateral lobes about 1 mm. long (free portion), rounded, obtuse; mid-lobe about 1.5 mm. long, transversely oblong, blunt, slightly exceeding the lateral lobes. Column slender, arcuate, about 10 mm. long; anther operculate, incumbent; pollinia 4, exappendiculate, ceraceous or appearing so, pyriform.

Panama.

COCLÉ: El Valle de Antón, alt. 1000 m., *Allen 2463;* alt. 500–700 m., *Seibert 459.*

2. PALMORCHIS POWELLII (Ames) Schweinf. & Correll in Bot. Mus. Leafl. Harv. Univ. 8:119. 1940.

Rolfea Powellii Ames, Sched. Orch. 7:32, *fig. 6.* 1924.

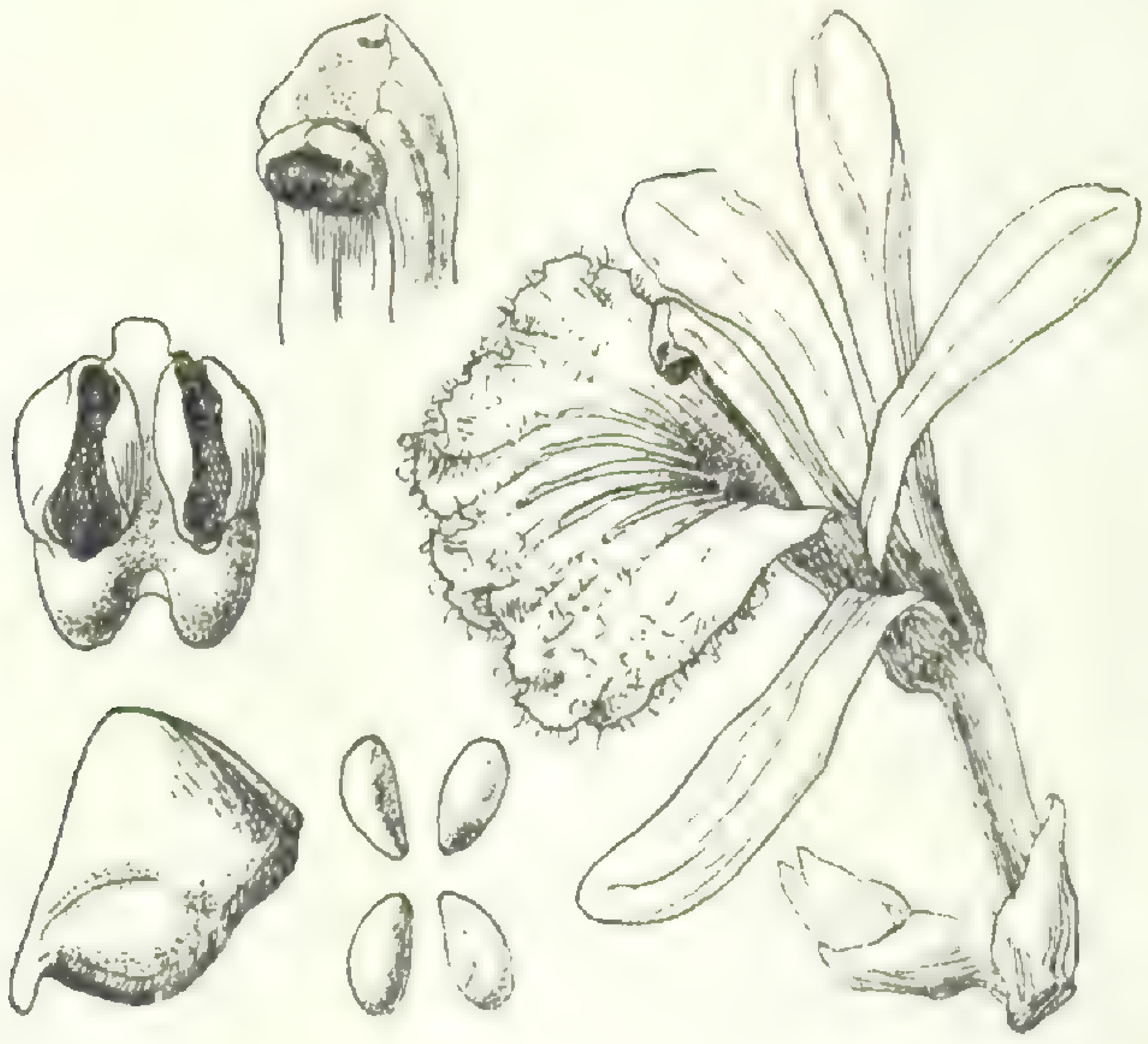


Fig. 74. *Palmorchis Powellii*

Caespitose, terrestrial herbs up to about 60 cm. tall. Stems about 30 cm. tall and 3–4 mm. in diameter. Leaves subchartaceous, plicate; lamina of the mature leaves 15–28 cm. long and 3–5 cm. broad, elliptic-lanceolate, acuminate, with 5–7 prominent nerves; petiole up to 8 cm. long, plicate, nervose. Inflorescence terminal or axillary, up to 5 cm. long, simple or branched; bracts 5–6 mm. long, ovate, acute. Flowers about 17 mm. long, white. Dorsal sepal about 15 mm. long and 3 mm. broad, spatulate, obtuse. Lateral sepals similar to the dorsal sepal but slightly arcuate. Petals about 15 mm. long and 3 mm. broad, rotundate-flabellate, trilobulate in front; disc pilose, with 5 parallel lamellae. Column about 12 mm. long, slender, arcuate.

Panama.

CANAL ZONE: Barro Colorado Island, *Starry 323;* "Juan Diaz," near Panamá City, *Powell 325.*

9. STENOPTERA Presl

STENOPTERA Presl, Rel. Haenk. 95, *t. 14,* 1827; L. Wms. in Caldasia 5:11. 1942.
Gomphichis Lindl. Gen. & Sp. Orch. Pl. 446. 1840.

Terrestrial leafy herbs. Leaves radical or cauline, contracted or petiolate at the base. Inflorescence a terminal, compact or loose spike. Flowers mostly small, non-resupinate. Sepals subequal or the dorsal narrower, free or joined into a short tube at the base, subconnivent to recurved. Petals linear to nearly as broad as the sepals. Lip uppermost, erect or parallel to the column, contracted or unguiculate at the base, simple or 3-lobed lamina plane or concave or subgaleate. Column subterete, erect, wingless, glabrous or villous; anther erect in the clinandrium; pollen granular or dust-like. Capsule ovoid, erect.

The single species known in Panama has been referred to *Gomphichis,* but there are several species, unknown to Lindley, which seem absolutely to close the gap between the two presumed genera.

1. STENOPTERA COSTARICENSIS Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:375. 1918.

Gomphichis costaricensis Ames, Hub. & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 3:37. 1934.

Terrestrial herbs up to about 6 dm. tall. Leaves basal or those on the stem reduced to bracts, 7–30 cm. long and 2.5–3.5 cm. broad, mostly elliptic-lanceolate,

acute or acuminate, contracted at the base into a broad petiole. Scape erect, with several bracts which are reduced upward, villous above but glabrescent below. Inflorescence a spike 3–16 cm. long. Dorsal sepal about 8 mm. long and 2.5 mm. broad, broadly elliptic, acute or acuminate, cucullate, 1-nerved, pubescent dorsally. Lateral sepals similar to the dorsal but more oblong and oblique. Petals 3.5–5 mm. long and 2.5–3.5 mm. broad, elliptic-ovate, acute or obtuse, ciliate or subfimbriate, slightly cucullate, 3-nerved. Lip 4–5 mm. long and 3–4 mm. broad, 3-lobed, slightly unguiculate; lateral lobes rounded; terminal lobe ovate, about 2 mm. long and 1.5 mm. broad, fleshy, villous; disc fleshy, villous; with a small marginal callus on either side at the base. Column about 3 mm. long, terete, straight or nearly so. Capsule ovoid.

Costa Rica, Panama, and possibly South America.

CHIRIQUÍ: Bajo Chorro, alt. 2000 m., *Davidson 163, 309.*

This species is an Andean type and has several close allies, if not synonyms, in the Andes.

10. PRESCOTTIA Lindl.

PRESCOTTIA Lindl. in Hook. Exot. Fl. 2: *t. 115.* 1824.

Small terrestrial herbs with basal or semi-basal leaves. Leaves usually radical (Panama), sessile or petiolate, membranaceous, large or small. Inflorescence a terminal spike. Flowers small, non-resupinate. Sepals connate at their bases into a tube, spreading or revolute. Petals narrow, adnate to the base of the column, often revolute. Lip uppermost, unguiculate and with the claw adnate to the sepals, lamina plane to concave, cucullate or galeate, biauriculate at the base, often enclosing the column. Column short; stigmata 2; clinandrium erect, acuminate or subfilamentous, the margins adnate to the rostellum; pollen granular or powdery.

A small genus with but two distinctive species known in Panama.

a. Lamina of the leaf less than 7 cm. long; petiole much shorter than the lamina .... 1. P. OLIGANTHA
aa. Lamina of the leaf more than 7 cm. long (usually 10–20 cm.); petiole about as long as the lamina .... 2. P. STACHYODES

1. PRESCOTTIA OLIGANTHA (Sw.) Lindl. Gen. & Sp. Orch. Pl. 454. 1840; C. Schweinf. in Bot. Mus. Leafl. Harv. Univ. 7:20. 1938.

Cranichis oligantha Sw. Prodr. Veg. Ind. Occ. 120. 1788.
Prescottia panamensis Schltr. in Fedde Rep. Sp. Nov. 16:357. 1920.

Small erect terrestrial herbs up to about 32 cm. tall. Leaves 1.5–7 cm. long and 0.8–3 cm. broad, basal, membranaceous, suberect or spreading, elliptic to cordate or obovate, acute or obtuse; petiole shorter than the lamina, usually much shorter. Scape erect, slender, glabrous, with several bracts which are reduced upward. Inflorescence up to 10 cm. long, a densely flowered spike. Sepals 1.5–3 mm. long and 0.6–1 mm. broad, oblong-ovate, obtuse, the laterals oblique, connate

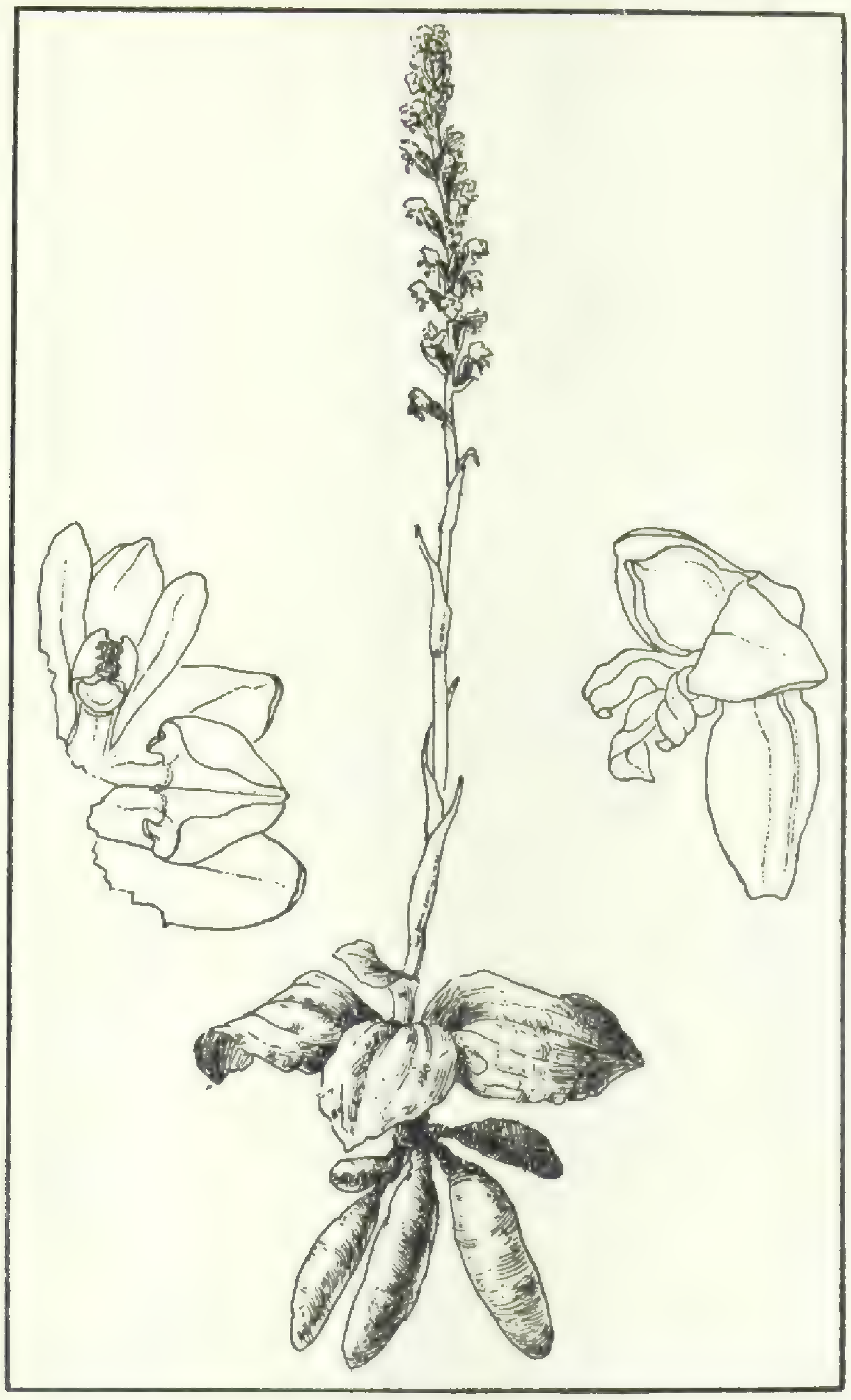


Fig. 75. *Prescottia oligantha*

into a short tube at the base and forming an inconspicuous mentum. Petals 1–1.5 mm. long and about 0.5 mm. broad, linear-oblong, obtuse, somewhat oblique. Lip 1.5–2 mm. long and as broad, suborbicular, strongly cucullate, with a small auriculate callus on either side at the base; the disc puberulent. Column about 0.5 mm. long.

Florida, Mexico, Costa Rica, Panama, the West Indies, Venezuela, and Colombia.

CHIRIQUÍ: Cerro Vaca, alt. 900–1000 m., *Pittier 5358*. COCLÉ: valley of upper Río Mata, alt. 350 m., *Allen 130;* vicinity of El Valle, alt. 600–1000 m., *Allen 1159*.

2. PRESCOTTIA STACHYODES (Sw.) Lindl. in Bot. Reg. 22: *sub t. 1916.* 1836; L. Wms. in Ann. Missouri Bot. Gard. 27:272. 1940.

Cranichis stachyodes Sw. Fl. Ind. Occ. 3:1427. 1799.

Terrestrial herbs, up to about 1 m. tall. Leaves basal, long-petiolate, large, membranaceous, suberect; petiole up to about 25 cm. long, slender; lamina 8–22 cm. long and 3–16 cm. broad (those of Panamanian specimens large), elliptic or elliptic-oval to broadly oval, acute, acuminate or obtuse, margin often sphacelate. Inflorescence a densely flowered spike up to about 30 cm. long. Sepals 3–5 mm. long and 0.75–1.25 mm. broad, linear-oblong, obtuse, 1-nerved, strongly coiled, connate at their bases into a short tube. Petals 3–5 mm. long and 0.2–0.5 mm. broad, linear, obtuse, 1-nerved. Lip 4–6 mm. long, strongly concave or calceiform, short-unguiculate, with a lateral callus on either side at the base, glabrous. Column about 2 mm. long.

Mexico, British Honduras, Guatemala, Honduras, Panama, the West Indies, Colombia, Brazil, and perhaps elsewhere in South America.

COCLÉ: vicinity of El Valle de Antón, alt. 600–1000 m., *Allen 1183;* same locality, *Allen 2064;* hills north of El Valle de Antón, vicinity of La Mesa, alt. about 1000 m., *Allen 2326;* mountains beyond La Pintada, *Hunter & Allen 623.*

11. CRANICHIS Sw.

CRANICHIS Sw. Nov. Gen. & Sp. Prodr. 8, 120. 1788.

Small terrestrial herbs with basal leaves or rarely with reduced cauline leaves. Leaves sessile or petiolate, membranaceous. Scape slender, simple, with several bracts. Inflorescence a terminal spike. Sepals free, similar, or the laterals often broader. Petals free or obscurely adnate to the base of the column. Lip uppermost (i. e. flowers non-resupinate), sessile or rarely unguiculate, adnate to the base or up to the middle of the column, erect, plane, concave or saccate. Column short; rostellum erect, often as long as the column; pollen granular.

A small genus with but one species known in Panama.

1. CRANICHIS MUSCOSA Sw. Nov. Gen. & Sp. Prodr. 120. 1788.

Small terrestrial herbs 10–38 cm. tall. Leaves petiolate, basal or semi-basal, usually with leaf-like bracts at the base of the scape, which are reduced upward; lamina 3–8 cm. long and 1–4 cm. broad, elliptic, elliptic-oval or oval, acute or obtuse, membranaceous; petiole 1–8 cm. long, usually a little shorter than the lamina. Dorsal sepal about 2.5 mm. long and 1 mm. broad, elliptic-lanceolate, cucullate, obtuse or acute. Lateral sepals about 2.5 mm. long and 1 mm. broad, ovate-lanceolate, oblique, obtuse or acute. Petals 2–3 mm. long and 0.3–0.5 mm. broad, linear or linear-oblanceolate. Lip 2.5–3 mm. long and 1.5–2 mm. broad, simple, strongly cucullate, elliptic-oval to oblong-oval, acute or acutish. Column 1–1.5 mm. long.

Florida, Mexico, Costa Rica, Panama, and the West Indies.

COCLÉ: vicinity of El Valle, alt. 800–1000 m., *Allen 74,* alt. 600–1000 m., *Allen 1235.*

12. PONTHIEVA R. Br.

PONTHIEVA R. Br. in Ait. Hort. Kew. ed. 2, 5:199. 1813; Benth. & Hook. Gen. Pl. 3:593. 1883.

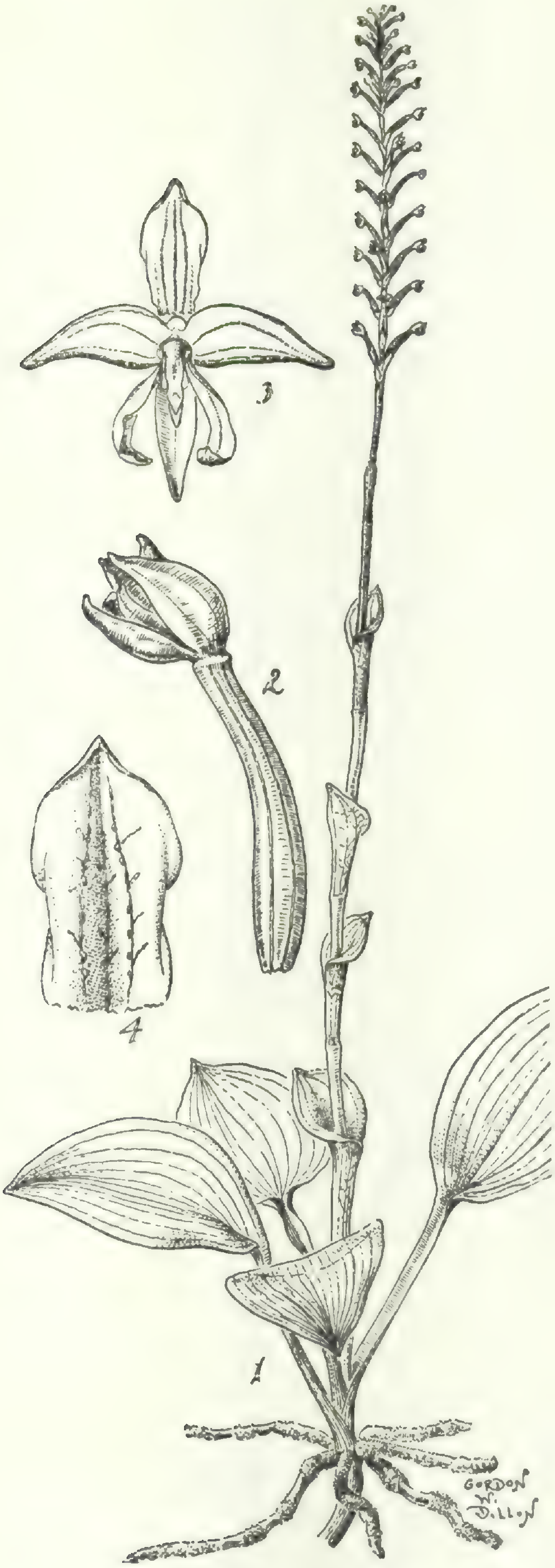


Fig. 76. *Cranichis muscosa*

Small glabrous or pilose terrestrial herbs with basal leaves and naked or bracteate scapes. Sepals free, spreading, subequal or dorsal smallest. Petals attached above the middle of the column, spreading. Lip uppermost (non-resupinate), adnate to the column by its unguiculate base, abruptly dilated from the claw. Pollinia granular.

A small genus limited to the warmer regions of the western hemisphere.

a. Leaves pilose-pubescent .... 3. P. maculata
aa. Leaves glabrous.
  b. Lip with 2 small calluses at the base of the blade .... 1. P. Ephippium
  bb. Lip without calluses at the base but the claw with a single callus .... 2. P. racemosa

1. Ponthieva Ephippium Reichb. f. in Linnaea 28:382. 1856; L. Wms. in Ann. Missouri Bot. Gard. 26:280. 1939.

Small terrestrial herbs up to about 3.5 dm. tall. Leaves basal, 5–12 cm. long and 1.2–3.5 cm. broad, petiolate, variable, elliptic to oblong to oblanceolate to oval or subcordate, acute or obtuse, membranaceous. Inflorescence a few–several-flowered raceme on a bracteate peduncle, pubescent. Flowers small, white. Dorsal sepal 4.5–7 mm. long and 1.5–2.5 mm. broad, elliptic to broadly oblanceolate, acute, pubescent dorsally. Lateral sepals 4.5–7 mm. long and 2–5 mm. broad, obliquely ovate, acute or obtuse, pubescent dorsally. Petals 4–6.5 mm. long and 1–3 mm. broad, oblique and with the anterior margin developed into a large sub-basal auricle or angle, unguiculate, obtuse. Lip 2–5 mm. long, trilobulate, unguiculate, attached near the apex of the column; the lamina from obovate in outline to transversely oblong, with 2 calluses near the base, mid-lobe small, about 0.5 mm. long; claw thickened.

Mexico, Guatemala, Honduras, and Panama.

CHIRIQUÍ: Finca Lérida to Boquete, alt. about 1300–1700 m., *Woodson, Allen & Seibert 1118.*

2. Ponthieva racemosa (Walt.) Mohr in Contr. U. S. Nat. Herb. 6:460. 1901; Ames & Schweinf. in Sched. Orch. 10:14. 1930.

Arethusa racemosa Walt. Fl. Carol. 222. 1788.
Neottia glandulosa Sims in Bot. Mag. 21: *t. 842.* 1805.
Ponthieva glandulosa R. Br. in Ait. Hort. Kew. ed. 2, 5:200. 1813.
Ponthieva rostrata Lindl. in Ann. & Mag. Nat. Hist. 15:385. 1845.
Ponthieva oblongifolia Rich. & Gal. in Ann. Sci. Nat. III, 3:30. 1845.
Ponthieva guatemalensis Reichb. f. in Beitr. Orch. Centr.-Am. 63. 1866.
Ponthieva costaricensis Schltr. in Fedde Rep. Sp. Nov. Beih. 19:84. 1923.

Mostly small terrestrial herbs up to about 6 dm. tall, but usually about 2–3 dm. tall. Leaves basal, 4–30 cm. long and 1.5–6 cm. broad, variable, elliptic to oblanceolate to ovate to obovate, acute, petiolate, glabrous. Inflorescence pubescent, a few–many-flowered, loose raceme; bracts prominent. Dorsal sepal 4–7 mm. long and 1.5–3 mm. broad, lanceolate, acute or acuminate, pubescent dorsally. Lateral sepals 4.5–7 mm. long and 2–4 mm. broad, oblique, lanceolate to ovate-

Fig. 77. *Ponthieva racemosa*

lanceolate, acute, pubescent dorsally. Petals 4.5–6 mm. long and 2–4 mm. broad, obliquely subovate or subtriangular, unguiculate, obtuse. Lip 4–7 mm. long and 2–5.5 mm. broad, trilobulate, unguiculate, suborbicular to subquadrate in outline; lamina fleshy, cucullate at the base; claw fleshy with a conspicuous callus at its base.

Virginia to Florida and Louisiana (U.S.A.), Mexico, Guatemala, Honduras, Costa Rica, Panama, the West Indies, and in South America to Peru.

CHIRIQUÍ: Volcán de Chiriquí, alt. 3500–4000 m., *Woodson & Schery 469*. COCLÉ: vicinity of El Valle, alt. 600–1000 m., *Allen 1161*. PANAMÁ: San Juan Range, alt. near sea-level, *Powell 356*.

3. PONTHIEVA MACULATA Lindl. in Ann. & Mag. Nat. Hist. 15:385. 1845; Hook. f. in Bot. Mag. 108: *t. 6637*. 1882.

Ponthieva Brenesii Schltr. in Fedde Rep. Sp. Nov. Beih. 19:165. 1923.

Small pubescent terrestrial herbs up to about 3 dm. tall. Leaves basal, 5–20 cm. long and 0.8–5.2 cm. broad, variable, linear-lanceolate or oblanceolate to ovate, acute or acuminate, petiolate, strigose-pubescent on both surfaces, membranaceous. Inflorescence a few–several-flowered raceme on a slender bracteate peduncle. Dorsal sepal 9–14 mm. long and 3–4.5 mm. broad, elliptic to lanceolate, acute or acuminate, pubescent dorsally. Lateral sepals 9–14 mm. long and 5.5–8 mm. broad, broadly oval to obovate, obtuse, pubescent dorsally. Petals 6–9 mm. long and 2–3 mm. broad, oblique, obtuse, angled toward the base anteriorally, short-unguiculate, inserted above the middle of the column. Lip 3–4 mm. long and 2–3 mm. broad, oblong to suborbicular, trilobulate, cucullate, with a hood-shaped callus which forms a cavity at the base, inserted near the apex of the column.

Mexico, Costa Rica, Panama, Venezuela, Colombia and Ecuador.

CHIRIQUÍ: Cerro Punto to headwaters of Río Caldera, alt. 2250–2500 m., *Allen 1430*.

One of the most pubescent orchids in Panama.

13. SPIRANTHES L. C. Rich.

SPIRANTHES L. C. Rich. in Mém. Mus. Par. 4:50. 1818, *nom. conserv.*; Schltr. in Beih. Bot. Centralbl. 37, Abt. 2:317-454. 1920.

Gyrostachys Pers. Syn. Pl. 2:511. 1807.
Stenorrhynchus L. C. Rich. in Mém. Mus. Par. 4:59. 1818.
Pelexia L. C. Rich. loc. cit. 59.
Sarcoglottis Presl, Rel. Haenk. 1:95, *t. 15*. 1827.
Cyclopogon Presl, loc. cit. 93.
Beloglottis Schltr. in Beih. Bot. Centralbl. 37, Abt. 2:364. 1920.
Brachystele Schltr. loc. cit. 370.

Small, or rarely large, terrestrial (rarely epiphytic) herbs with basal or cauline leaves or both, or leafless. Roots often fleshy, fasciculated or tuberous. Leaves various, produced before, with, or after, the flowers. Sepals free; dorsal sepal usually erect and forming a galea with the petals; lateral ones erect or spreading,

affixed to the summit of the ovary, decurrent and forming a free or adnate mentum. Petals usually narrow and usually coherent to the dorsal sepal. Lip sessile or clawed, plane, concave or gibbous, simple or lobed, in some species bicaudate at the base, adherent to the column in almost all the species, ecallose or callose. Column terete; clinandrium often membranaceous and conspicuous, often continued into the rostellum; rostellum various, inconspicuous or conspicuous, truncate and retuse to lobed to aristate; anther dorsal, erect, sessile or stipitate; pollinia 2, powdery or granular, usually attenuated at one end.

A large and technical genus with its main center of distribution in Mexico.

a. Lip less than 8 mm. long.
  b. Lip less than 3 mm. long .... 1. S. GUYANENSIS
  bb. Lip 5 mm. or more long.
    c. Lateral sepals linear-ligulate to ligulate; petals oblanceolate-ligulate .... 2. S. COSTARICENSIS
    cc. Lateral sepals linear-lanceolate to narrowly lanceolate-triangular; petals linear to narrowly elliptic .... 3. S. PRASOPHYLLUM
aa. Lip 13 mm. long or longer.
  b. Lateral sepals forming a produced, acute or obtuse mentum at the base.
    c. Lip bicaudate at the base .... 9. S. FUNCKIANA
    cc. Lip not bicaudate at the base .... 8. S. ORCHIOIDES
  bb. Lateral sepals not forming a produced, obtuse or acute mentum at their base.
    c. Lip not bicaudate at the base; rostellum terete .... 6. S. SPECIOSA
    cc. Lip bicaudate at the base; rostellum flattened or terete.
      d. Terminal part of the lip not oval nor suborbicular nor with pubescent callus-ridges; rostellum terete .... 7. S. NAVARRENSIS
      dd. Terminal part of the lip oval or suborbicular or with pubescent callus ridges; rostellum flattened.
        e. Base of the stem leafy; plants from rhizomes .... 4. S. WOODSONII
        ee. Base of the stem not leafy; plants from fascicled roots .... 5. S. ACAULIS

1. SPIRANTHES GUYANENSIS (Lindl.) Cogn. in Mart. Fl. Bras. 3^4:209, *t. 47, f. II.* 1895.

Goodyera guyanensis Lindl. Gen. & Sp. Orch. Pl. 494. 1840.
Brachystele guyanensis Schltr. in Beih. Bot. Centralbl. 37, Abt. 2:373. 1920.
Spiranthes aguacatensis Reichb. f. in Bonplandia 3:214. 1855; Ames, Sched. Orch. 2:7. 1923.
Gyrostachys aguacatensis O. Ktze. Rev. Gen. 2:664. 1891.
Brachystele aguacatensis Schltr. loc. cit. 371.

Erect terrestrial herbs up to 20 cm. tall. Stems with several loose, lanceolate or ovate-lanceolate, acuminate bracts. Leaves unknown. Inflorescence up to 6 cm. long, densely flowered. Dorsal sepal 2–3 mm. long and about 0.7–1.5 mm. broad, lanceolate, acute or obtuse. Lateral sepals 2–3 mm. long and 0.7–1.5 mm. broad, lanceolate-triangular, acute or obtuse, somewhat oblique. Petals 2–2.5 mm. long and 0.6–0.9 mm. broad, oblanceolate-spatulate, truncate, or obtuse, coherent to the dorsal sepal, unguiculate. Lip 2–2.8 mm. long and 1.7–2.2 mm. broad, oblong-pandurate to ovate or suborbicular and constricted toward the apex, the terminal lobe small, oblong to suborbicular, with two retrorse auricles or caudae at the base.

Mexico, Guatemala, Honduras, Costa Rica, Panama, Trinidad, the Guianas, Colombia, and Bolivia.

CANAL ZONE: open fields near railway station, Monte Lirio, *Maxon 6862*.

The smallest-flowered species of *Spiranthes* in Panama.

2. SPIRANTHES COSTARICENSIS Reichb. f. in Bonplandia 3:214. 1855; Beitr. Orch. Centr.-Am. 46. 1866; Xenia Orch. 2:185, *t. 179, f. I, 1-3b.* 1868; Ames, Sched. Orch. 9:7. 1925.

Gyrostachys costaricensis O. Ktze. Rev. Gen. 2:664. 1891.
Beloglottis costaricensis Schltr. in Beih. Bot. Centralbl. 37, Abt. 2:365. 1920.
Spiranthes subpandurata Ames & Schweinf. Sched. Orch. 8:4, *f. 1.* 1925.

Erect terrestrial or epiphytic herbs with basal leaves, or leafless at flowering time, up to 4.5 dm. tall. Leaves 3–18 cm. long and 1–5 cm. broad, elliptic to oval or oblanceolate, acute or acuminate, membranaceous, petiolate; petiole 2–8 cm. long. Inflorescence a few–many-flowered raceme, up to about 20 cm. long. Dorsal sepal 4–6.5 mm. long and 1–1.5 mm. broad, lanceolate, acute, pubescent dorsally. Lateral sepals 4–6.5 mm. long and 0.7–1.3 mm. broad, linear-ligulate to ligulate, acute or obtuse, pubescent dorsally. Petals 3.5–6 mm. long and 0.7–1 mm. broad, oblanceolate-ligulate, acute or obtuse, oblique, coherent to the dorsal sepal. Lip 5–6.5 mm. long and 1.5–2 mm. broad, lanceolate-pandurate, short-unguiculate, retrorsely bicaudate at the base.

Mexico, Guatemala, Honduras, Costa Rica and Panama.

CANAL ZONE: upper Chagres River Range, *Powell 377*.

A species easy to distinguish because of the unusual lip shape.

3. SPIRANTHES PRASOPHYLLUM Reichb. f. Beitr. Orch. Centr.-Am. 65. 1866; Ames, Sched. Orch. 9:8. 1925.

Gyrostachys Prasophyllum O. Ktze. Rev. Gen. 2:664. 1891.
Spiranthes epiphytica Schltr. in Fedde Rep. Sp. Nov. 2:130. 1906.
Cyclopogon Prasophyllum Schltr. in Beih. Bot. Centralbl. 37, Abt. 2:393. 1920.

Small epiphytic herbs 8–25 cm. tall, with basal leaves. Leaves short-petiolate; lamina 3–13 cm. long and 0.8–2.8 cm. broad, elliptic, acute; petiole 1–4 cm. long. Inflorescence 2–8 cm. long, the flowers often unilateral. Dorsal sepal 5–6 mm. long and 1–1.5 mm. broad, lanceolate, acute or acuminate, pubescent at the base dorsally. Lateral sepals 5–6.5 mm. long and 1–1.8 mm. broad, linear-lanceolate to narrowly lanceolate-triangular, acute, pubescent at the base dorsally. Petals 4–5 mm. long and 0.5–1 mm. broad, linear to narrowly elliptic, acute or obtuse, coherent to the dorsal sepal. Lip 5–7 mm. long and 2–3 mm. broad, narrowly oblong-pandurate to lanceolate-ovate and constricted toward the apex; apical lobe oblong to transversely oval or reniform, bicaudate at the base, the caudae retrorse or incurved.

Guatemala, Honduras, Costa Rica, and Panama.

COCLÉ: north of El Valle de Antón, alt. about 1000 m., *Allen 2904*. CANAL ZONE: Gatún, *Hayes 138;* forest, Río Indio at Gatún, *Maxon 4816*.

Fig. 78. *Spiranthes Prasophyllum*

4. Spiranthes Woodsonii L. Wms. in Ann. Missouri Bot. Gard. 29:337. 1942.

Terrestrial palustrine herbs up to 5.5 dm. tall. Rhizomes slender, rooting at most of the nodes, with scarious sheaths arising from the nodes. Stems slender, with well-developed leaves at the base which become bract-like above, glabrous

below but becoming densely pubescent above. Leaves 3–10 cm. long, 1.3–2.8 cm. broad, oblong-elliptic to oval, acute or obtuse, largest near the base of the stem and reduced to amplexicaul bracts above. Inflorescence up to 10 cm. long, flowers congested, becoming more open in fruit; bracts up to 4 cm. long and 1.6 cm. broad, lanceolate, acuminate, pubescent dorsally. Flowers large, similar to those of *S. acaulis*. Dorsal sepal 16.5–19 mm. long and 3.5–4 mm. broad, lanceolate, acuminate, 3–5-nerved, densely pubescent dorsally. Lateral sepals long-decurrent on the ovary, 35–40 mm. long from the apex to the base of the saccate mentum; free part 16.5–19 mm. long and 4–4.5 mm. broad, lanceolate, acuminate, arcuate, spreading, densely pubescent dorsally, 3–5-nerved. Petals 15–18 mm. long and 2–2.5 mm. broad, narrowly elliptic to narrowly oblanceolate, pubescent or ciliate near the margins of the basal half. Lip 28–32 mm. long and 6–7 mm. broad (apical lobe), linear-oblong and somewhat expanded and pandurate in the terminal third, caudate, with two extremely pubescent converging callus-ridges on the terminal third, the basal part densely pubescent and the remainder, except the glabrous apex, less pubescent, glabrous dorsally except at the base; terminal lobe oval or transversely rhombic; caudae about 5 mm. long, retrorse, fleshy but flattened.

Panama.

CHIRIQUÍ: vicinity of El Boquete, alt. 1000–1500 m., *Cornman 2050;* vicinity of Boquete, alt. 1200–1500 m., *Woodson & Schery 753;* in swampy meadows, Finca Lérida to Boquete, alt. about 1300–1700 m., *Woodson, Allen & Seibert 1148.*

Very few species of *Spiranthes* have rhizomes.

5. Spiranthes acaulis (J.E.Sm.) Cogn. in Mart. Fl. Bras. 3⁴:221. 1895.

Neottia acaulis J. E. Smith, Exot. Bot. 2:91, *t. 105.* 1806.
Arethusa picta Anders. in Trans. Soc. Arts. 25. 1807.
Neottia picta R. Br. in Ait. Hort. Kew. ed. 2, 5:199. 1813; Sims in Bot. Mag. 37: *t. 1562.* 1813.
Sarcoglottis picta Klotzsch in Allgem. Gartenz. 10:106. 1842; Schltr. in Beih. Bot. Centralbl. 37, Abt. 2:419. 1920.
Gyrostachys picta O. Ktze. Rev. Gen. 2:664. 1891.
Sarcoglottis Hunteriana Schltr. in Fedde Rep. Sp. Nov. Beih. 17:13. 1922.
Sarcoglottis Powellii Schltr. loc. cit. 14.
Sarcoglottis Purpusiorum Schltr. in Fedde Rep. Sp. Nov. 21:333. 1925.

Large terrestrial herbs with basal leaves or with the leaves withered at flowering time, up to 1 m. tall but more commonly 3–4 dm. tall. Leaves petiolate or epetiolate; lamina 6–18 cm. long and 4–7 cm. broad when mature, elliptic to oval to oblanceolate or obovate, acute or obtuse, membranaceous, mottled; petiole short or none. Inflorescence up to 2 dm. long, few–many-flowered; bracts up to 4 cm. long, linear to linear-lanceolate, acuminate. Dorsal sepal 15–22 mm. long and 3–4 mm. broad, ligulate, acute, pubescent dorsally. Lateral sepals 40–50 mm. long and 4–7 mm. broad, free part 18–28 mm. long, lanceolate, acute, arcuate, pubescent dorsally, basal part decurrent on the ovary and extending almost to the base. Petals 14–24 mm. long and 2–4 mm. broad, linear-lanceolate or usually

linear-oblanceolate, acute or obtuse, slightly arcuate, coherent to the dorsal sepal. Lip 30–40 mm. long and 7–11 mm. broad, essentially narrowly oblanceolate, obtuse, the dilated apical portion constricted and with an oval or suborbicular terminal lobe, disc pubescent below the constriction, bicaudate at the base, the caudae fleshy, retrorse.

From Mexico through Central America and the West Indies, in South America to northern Argentina.

CANAL ZONE: Culebra, *Pittier 3427;* near Panama City, San Juan, Manteca, Mata Redonda, Juan Diaz, Arias Hill, Frijoles, *Powell 147, 179, 388, 389, 390, 391, 392, 394, 395, 398, 399, 3435, 3521, 3525, 3531, 3532, 3534, 3536, 3541, 3551, 3567, 3568, 3569, 3570.*

Known in Panama only from the Canal Zone where it grows in fairly open situations. A variable species.

6. SPIRANTHES SPECIOSA (J. F. Gmel.) A. Rich. in La Sagra, Hist. Isla Cub. ed. 2, 11:252. 1850.

Satyrium plantagineum L. Syst. Veg. ed. 10, 1244. 1758-59, non *Spiranthes plantaginea* Lindl., Spreng. vel Torr.
Serapias speciosa J. F. Gmel. Syst. 59. 1791.
Neottia speciosa Jacq. Ic. Pl. Rar. 3: *t. 600.* 1793; Sims' Bot. Mag. 33: *t. 1374.* 1811; Hook. Exot. Fl. 1: *t. 3, 4.* 1823.
Stenorrhynchus speciosus L. C. Rich. in Mém. Mus. Par. 4:59. 1818.
Spiranthes colorata N. E. Br. in Gard. Chron. n. s. 19:210. 1883.

Erect terrestrial or epiphytic herbs up to 4 dm. tall, with a rosette of basal leaves at flowering time. Leaves 4–18 cm. long and 1–8 cm. broad, elliptic to ovate or obovate, acute or acuminate; petioles 2–15 cm. long. Stems with several amplexicaul bracts. Inflorescence up to 10 cm. long, flowers congested; bracts up to 5 cm. long, linear-lanceolate, acuminate, usually red. Dorsal sepal 12–14 mm. long and 3–4 mm. broad, lanceolate, acute or acuminate, glabrous. Lateral sepals 12–15 mm. long and 3–4 mm. broad, lanceolate to narrowly lanceolate-triangular, acute or acuminate, forming a short mentum at the base. Petals 12–14 mm. long and 3–3.5 mm. broad, lanceolate or elliptic-lanceolate, somewhat arcuate, acute or acuminate, coherent to the dorsal sepal. Lip 13–15 mm. long and 4.5–5 mm. broad, terminal lobe lanceolate or oblong, acute, basal part oblong, pandurate, the basal margins somewhat thickened, disc pubescent.

Mexico, Guatemala, Honduras, Costa Rica, Panama, the West Indies, and in South America.

CHIRIQUÍ: vicinity of "New Switzerland," central valley of Río Chiriquí Viejo, alt. 1800–2000 m., *Allen 1382;* Salta Boquete, Boquete District, alt. 5500 feet, *Terry 1267.*

7. SPIRANTHES NAVARRENSIS (Ames) L. Wms. in Ann. Missouri Bot. Gard. 29:337. 1942.

Stenorrhynchus navarrensis Ames, Sched. Orch. 9:13, *f. 3.* 1925.

Erect or ascending terrestrial herbs up to about 5 dm. tall. Leaves basal, petiolate; lamina 7–16 cm. long and 3.5–8.5 cm. broad, narrowly to broadly

ovate, acuminate, membranaceous, often oblique; petiole 9–20 cm. long, winged and closed or sheathing at the base. Peduncle usually erect, with several membranaceous, sheathing bracts. Inflorescence up to 10 cm. long, few–many-flowered. Dorsal sepal 18–21 mm. long and 3.5–4.5 mm. broad, lanceolate, acute. Lateral sepals 18–22 mm. long and 3–4 mm. broad, lanceolate, more or less oblique. Petals 16–20 mm. long and about 2 mm. broad, linear-lanceolate, acute, subsigmoid, connate to the dorsal sepal. Lip 16–18 mm. long and 4–7 mm. broad, essentially lanceolate, constricted just above the base and again above the middle, auriculate at the base, the auricles fleshy. Anther up to 11 mm. long.

Costa Rica and Panama.

CHIRIQUÍ: cloud forest, Cerro Horqueta, alt. about 2000 m., *von Hagen & von Hagen 2111.*

Closely allied to S. *speciosa.*

8. SPIRANTHES ORCHIOIDES (Sw.) L. C. Rich. in La Sagra, Hist. Isla Cuba, ed. 2, 11:252. 1850.

Satyrium orchioides Sw. Nov. Gen. & Sp. Prodr. 118. 1788.
Neottia orchioides Sw. Fl. Ind. Occ. 3:1411. 1799; Sims in Bot. Mag. 25: *t. 1036.* 1807; Edwards' Bot. Reg. 9: *t. 701.* 1823.
Stenorrhynchus orchioides L. C. Rich. in Mém. Mus. Par. 4:59. 1818.
Spiranthes jaliscana S. Wats. in Proc. Am. Acad. 26:153. 1891.
Stenorrhynchus jaliscana Nash in Bull. Torr. Bot. Club 22:158. 1895.

Strict, leafless (at flowering time), terrestrial herbs up to 7 dm. tall but normally about 3 dm. tall. Leaves appearing after the flowering stage, 15–21 cm. long and 2.5–4 cm. broad, elliptic, membranaceous. Stems with several amplexicaul bracts which occasionally become leaf-like below. Sepals connivent or spreading at the tips, pubescent dorsally. Dorsal sepal 13–21 mm. long and 3–6 mm. broad, lanceolate, acute. Lateral sepals 18–27 mm. long and 3–4.5 mm. broad, lanceolate, acute, the bases decurrent on the ovary and at the base forming a protruded, acute or obtuse mentum. Petals 12–15 mm. long and 2.2–4.5 mm. broad, elliptic to elliptic-linear, acute or obtuse, coherent to the dorsal sepal. Lip 15–23 mm. long and 5.5–9 mm. broad, lanceolate, acute or acuminate, the margins of the broad claw fleshy and pubescent.

Florida and Mexico through Central America to Panama, the West Indies, and in South America to northern Argentina.

CANAL ZONE: Summit, alt. 75 m., *Allen 2453;* Bella Vista, Ceiba Tierra, Monte Lirio, near Gatún, La Chorrera, Tecúmen, Tapia, Mt. McComber, Mata Redonda, *Powell 386, 387, 393, 396, 402, 404, 407, 408, 409, 410, 414, 3454, 3527, 3547, 3557, 3559.*

The flowers of this species vary in color from white to brilliant red. In Panama they are often greenish. A widespread and variable species.

9. SPIRANTHES FUNCKIANA Rich. & Gal. in Ann. Sci. Nat. III, 3:32. 1845.

Pelexia Pringlei Fernald in Proc. Am. Acad. 35:562. 1900.
Pelexia Funckiana Schltr. in Fedde Rep. Sp. Nov. 15:197. 1918, as *P. Funkiana;* Ames & Schweinf. Sched. Orch. 8:3. 1925.

Fig. 79. *Spiranthes orchioides*

Pelexia guatemalensis Schltr. loc. cit. 197.
Pelexia congesta Ames & Schweinf. Sched. Orch. 10:5. 1930.

Slender terrestrial herbs up to 4.5 dm. tall. Leaves basal, petiolate; lamina 6–13 cm. long and 1.5–5 cm. broad, lanceolate to ovate, acute or acuminate, membranaceous; petiole 3–10 cm. long. Inflorescence up to 13 cm. long, several–many-flowered, lax or dense; bracts 1–3 cm. long, linear or linear-lanceolate, acuminate, somewhat pubescent dorsally. Dorsal sepal 14–19 mm. long and 4–5 mm. broad, oblanceolate, obtuse or acute, pubescent dorsally. Lateral sepals 25–35 mm. long and 3–3.5 mm. broad, linear-oblanceolate, acute, pubescent dorsally, oblique, free part strongly recurved, 14–18 mm. long, the basal part adnate to and decurrent on the ovary, 12–16 mm. long, forming a free spur-like projection at the base. Petals 14–19 mm. long and 2.5–3 mm. broad, linear-oblanceolate, acute or obtuse, coherent to the dorsal sepal. Lip 18–27 mm. long and 4–6.5 mm. broad, linear, subpandurate, with two retrorse auricles at the base, the disc puberulent toward the base.

Mexico, Guatemala, Honduras, Panama, and possibly South America.

COCLÉ: hills north of El Valle de Antón, vicinity of La Mesa, alt. about 1000 m., *Allen 2315*.

14. ERYTHRODES Blume

ERYTHRODES Blume, Bijdr. Fl. Nederl. Ind. 410, *t. 72*. 1825.
Physurus L. C. Rich. in Mém. Mus. Par. 4:55. 1818, *nomen*.

Terrestrial herbs with semi-basal or cauline leaves. Sepals free, nearly equal, erect or spreading. Petals connate toward their apices and usually coherent to the dorsal sepal and with it forming a galea. Lip simple or lobed, slightly adnate to the column for a short way, extended into a simple or didymous spur at the base which usually contains four or more mammillate calli or callus-like structures at the base. Column short. Pollinia sectile or granular.

A genus found in the tropics and subtropics of both hemispheres. The species are difficult to interpret.

A single species recognized in Panama.

1. ERYTHRODES KILLIPII Ames in Proc. Biol. Soc. Wash. 34:150. 1921.

Erect or ascending terrestrial herbs from a creeping rhizome, up to 1 m. or more long. Stems leafy toward the base, slender. Leaves petiolate; lamina 6–13 cm. long and 2–4.5 cm. broad, lanceolate to ovate or suborbicular, acuminate or acute, often oblique, membranaceous; petioles 2–5 cm. long, inflated and scarious at the base, semiamplexicaul. Sepals connate nearly to their apices. Dorsal sepal 5–7 mm. long and 2–3 mm. broad, lanceolate to oblong-lanceolate, obtuse or acute, pubescent dorsally. Lateral sepals 5.5–7 mm. long, 1.5–2.5 mm. broad, narrowly elliptic to oblong-lanceolate, obtuse or acutish, pubescent dorsally. Petals 5–6.5 mm. long and 1.5–2.5 mm. broad, oblanceolate, obtuse. Lip saccate; lamina

5–6.5 mm. long and 2.5–3.5 mm. broad, the basal part oblong, canaliculate, fleshy, the terminal lobe bi- or trilobulate, transverse, often ciliolate; sac 4–5 mm. long, obtuse, straight or curved slightly.

COCLÉ: vicinity of El Valle, alt. 1000 m., *Allen 1201* and *1792*. CHIRIQUÍ: Bajo Chorro, alt. 6000 feet, *Davidson 317*; valley of the Río Caldera from El Boquete to the Cordillera, alt. 1400–1600 m., *Killip 3561*.

More adequate material may show that the specimens from Coclé represent a different species.

15. CORYMBORCHIS Thouars

CORYMBORCHIS Thouars, Orch. Iles Afr. *tt. 37, 38*. 1822.

Corymbis Thouars, loc. cit., is *Corymborchis* by elision.

Terrestrial herbs with plicate or subplicate leaves and often with branched stems. Sepals and petals connivent into a tube at the base, usually linear with the petals dilated at the apex. Lip canaliculate, erect from the base of the column and free from it, apex usually dilated and recurved. Column erect, slender, the apex clavate, bilobed; anther erect, acuminate, subequal to the rostellum; pollinia 2, granular.

The genus is pantropic, with two species in the western hemisphere.

1. CORYMBORCHIS FLAVA (Sw.) O. Ktze. Rev. Gen. Pl. 2:658. 1891.

Serapias flava Sw. Nov. Gen. & Sp. Pl. Prodr. 119. 1788.
Corymbis flava Hemsl. in Godm. & Salv. Biol. Centr.-Am. Bot. 3:297. 1884.

Tall, slender, terrestrial, leafy herbs up to 15 dm. tall. Stems up to about 6 mm. in diameter, covered with the leaf sheaths. Leaves when mature 25–45 cm. long and 3.5–7 cm. broad, elliptic or elliptic-lanceolate, acuminate, plicate, sessile or nearly so. Inflorescence a simple raceme or a panicle from the axils of the upper leaves, up to 13 cm. long; bracts up to 10 mm. long, ovate, acute. Dorsal sepal 13–15 mm. long and about 2.5 mm. broad, linear to linear-lanceolate, acute. Lateral sepals 13–15 mm. long and about 2 mm. broad, linear or linear-lanceolate, acute or arcuate. Petals 13–14 mm. long and about 4 mm. broad, oblanceolate, acute. Lip 12–15 mm. long and 4–7 mm. broad, lanceolate to ovate-lanceolate, acute, cucullate, with a callus ridge extending along the margins from the base up to the middle or beyond.

British Honduras, Salvador, Costa Rica, Panama, the West Indies, also in South America.

CHIRIQUÍ: llanos, on slope of Volcán de Chiriquí Viejo, alt. 1200 m., *Allen 1009*.

16. STELIS Swartz

STELIS Swartz in Schrader's Jour. f. Bot. 2:239. 1799; in Svenska Vet.-Akad. Handl. 21:248. 1800, *nom. conserv.*

Humboltia Ruiz & Pavon, Fl. Peruv. et Chil. Prodr. 121, *pl. 27*. 1794, non Vahl.

Small to fairly large epiphytic herbs with caespitose or repent stems; secondary stems terminated by a single, usually fleshy, often petiolate leaf. Sepals subequal or the dorsal longest, more or less connate at the base, the laterals sometimes connate to their tips *(S. Allenii)*. Petals much smaller than the sepals, broad, often flabellate, anterior margin usually thickened. Lip sessile, simple or 3-lobed, usually fleshy and about as long as the column. Column short, footless; stigmas confluent or separated. Anther terminal, operculate, incumbent, biloculate; pollinia 2, ceraceous.

A difficult genus to study because the petals and lip are usually very small and often extremely fleshy.

a. Lateral sepals conspicuously shorter than the dorsal sepal, connate to the middle or beyond.
- b. Lip ovate with the thick central callus concave in front.......... 3. S. DESPECTANS
- bb. Lip not ovate, without a thickened central callus.
  - c. Dorsal sepal more than 10 mm. long, lanceolate.......... 1. S. ALLENII
  - cc. Dorsal sepal less than 5 mm. long, oblong.......... 2. S. INAEQUALIS

aa. Lateral sepals not conspicuously shorter than the dorsal sepal, connate only at their bases.
- b. Lip up to more than twice as long as broad.
  - c. Dorsal sepal 3.5 mm. or more broad; leaves 3 cm. or more broad.......... 5. S. MONTANA
  - cc. Dorsal sepal less than 3 mm. broad; leaves 2 cm. or less broad.
    - d. Sepals 4 mm. or more long, lanceolate-ovate to oblong-lanceolate, inner surface glandular.......... 7. S. SKUTCHII
    - dd. Sepals 3 mm. or less long, triangular to orbicular.
      - e. Lip 1–1.5 mm. long; sepals triangular.......... 6. S. ATRORUBENS
      - ee. Lip 0.5–0.6 mm. long; sepals ovate to orbicular.......... 4. S. MICROCHILA
- bb. Lip about as long as broad or broader than long.
  - c. Lip produced into an apicule or acumen in front.
    - d. Lip produced into a broad acumen, acumen not erect.......... 8. S. HYMENANTHA
    - dd. Lip produced into an inconspicuous apicule (sometimes 3) or a fleshy erect apicule.
      - e. Apicule fleshy, erect.......... 9. S. CRESCENTIICOLA
      - ee. Apicule not fleshy, erect.
        - f. Sepals 2–4 mm. long, usually 3-nerved.......... 11. S. ENDRESII*
        - ff. Sepals 4–9 mm. long, usually 5-nerved.......... 10. S. LEUCOPOGON*
  - cc. Lip not produced into an apicule or acumen in front.
    - d. Callus of the lip cruciform; bracts on rachis prominent, acute or acuminate.......... 12. S. POWELLII
    - dd. Callus of the lip not cruciform.
      - e. Callus of the lip longitudinal; lip with two minute auricles at the base; plants mostly less than 5 cm. tall.......... 13. S. STORKII
      - ee. Callus of the lip transverse; lip without auricles at the base; plants mostly more than 5 cm. tall.
        - f. Inflorescence subequal to or shorter, or but slightly longer than the subtending leaves.......... 14. S. MAXONII
          .... and 15. S. PANAMENSIS**
        - ff. Inflorescence twice or more longer than the subtending leaves.
          - g. Secondary stems usually 3 cm. long or longer.
            - h. Sepals densely glandular-pubescent within.......... 16. S. VESTITA
            - hh. Sepals not densely glandular-pubescent within, rarely pubescent.......... 17. S. AEMULA
          - gg. Secondary stems 3 cm. or less long.
            - h. A callus-ridge running at right angles to the transverse callus toward base of lip.......... 18. S. COLLINA

Fig. 80. *Stelis Allenii*

hh. No callus-ridge running at right angles to the transverse callus.
i. Sepals 3.5–4.5 mm. long .... 19. S. Williamsii
ii. Sepals 1.5–2.5 mm. long.
j. Bracts of the inflorescence almost contiguous .... 17. S. aemula
jj. Bracts of the inflorescence well separated .... 20. S. longipetiolata

* These two species appear somewhat different but perhaps are not distinct.
** S. *panamensis* would seem to key out here also, but the material available is so scanty that it can not be properly placed.

1. Stelis Allenii L. Wms. in Ann. Missouri Bot. Gard. 29:338. 1942.

Large caespitose epiphytic herbs up to 4 dm. tall. Secondary stems 7–15 cm. long and 0.25–0.35 cm. in diameter, covered with two or three loose sheaths which soon disentegrate, shorter than the leaves. Leaves 10–19 cm. long and 3.5–7 cm. broad, elliptic to elliptic-oval, acute or obtuse, coriaceous, attenuated into a short petiole at the base. Inflorescence up to 30 cm. long, floriferous to the base, one or more borne from the apex of the stems (if more than one then presumably borne in different years); sheaths up to 2.5 cm. long, cucullate, ample; bracts 2–18 mm. long, reduced upwards, ovate-lanceolate, acute or acuminate, infundibuliform; flowers largest of the genus. Dorsal sepal 14–16 mm. long and 5–6 mm. broad, lanceolate, acute, 11–13-nerved, cucullate. Lateral sepals connate to their apices, together 10–12 mm. long and 8–10 mm. broad, suborbicular-ovate, acute or obtuse, cucullate and gibbous at the base, many-nerved. Petals about 1 mm. long and 1.5 mm. broad, broadly flabellate to transversely oval, the apex much thickened. Lip 0.75–1 mm. long and 1–1.4 mm. broad, about 0.75 mm. thick at the apex, flabellate, truncate, the transverse callus at the apex of the lip, very like the petals but slightly smaller.

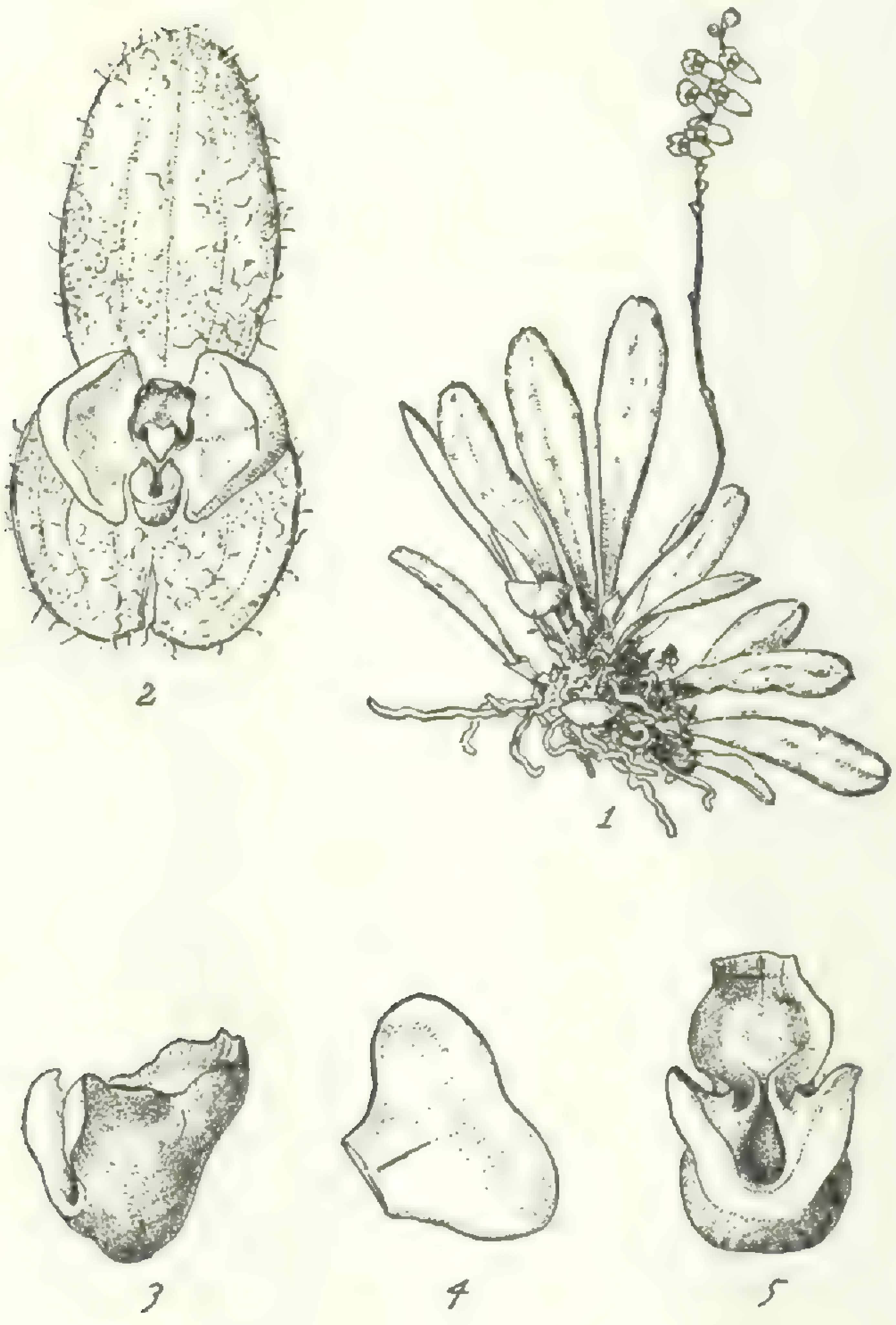
Endemic in Panama.

coclé: hills north of El Valle de Antón, alt. 800 m., *Allen 2952*.

Stelis Allenii is perhaps the most distinctive species of the genus in Central America and seems to be the largest-flowered. There are no near allies in Central America but the species seems to belong to Lindley's section Dialissa, a section with but a few species in the Andes.

2. Stelis inaequalis Ames, Sched. Orch. 4:12. 1923; in Bot. Mus. Leafl. Harv. Univ. 3:155, *t.* 1935.

Small, caespitose, epiphytic herbs up to about 5 cm. tall. Secondary stems about 3 mm. long, concealed by the sheathing bracts. Leaves 1.5–2.5 cm. long and 0.4–0.5 cm. broad, oblanceolate, obtuse, emarginate, coriaceous. Inflorescence up to 5 cm. long, exceeding the leaves; bracts about 1 mm. long, infundibuliform. Dorsal sepal 2–2.5 mm. long and 1–1.4 mm. broad, elliptic-oblong, obtuse, puberulent ventrally. Lateral sepals 1–1.4 mm. long and together 1.6–2 mm. broad, connate to beyond the middle. Petals 0.5–0.75 mm. long and 0.75–1 mm. broad, flabellate. Lip 0.6–0.75 mm. long and about 0.35–0.5 mm. broad, rather thin below the middle and much thickened above, strongly concave in front of the obtuse apex.



STELIS *inaequalis* Ames

Fig. 81

Honduras and Panama.

PANAMÁ: foothills, upper reaches of Chagres River near San Juan, alt. near sea-level, *Powell 271*.

3. STELIS DESPECTANS Schltr. in Fedde Rep. Sp. Nov. 8:453. 1910.

Stelis chiriquensis Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:386. 1918.
Stelis nutantiflora Schltr. loc. cit. 390.

Caespitose epiphytic herbs up to about 25 cm. tall. Secondary stems 2–12 cm. long, about as long as or shorter than the leaves. Leaves narrowed to a petiole at the base; lamina 2–12 cm. long and 2–7 mm. broad, linear-elliptic or linear-oblanceolate; petiole up to 4 cm. long, slender. Inflorescence about as long as or exceeding the leaves in length. Sepals connate at the base for a short distance; dorsal sepal 2–3 mm. long and 0.75–1.5 mm. broad, lanceolate-oblong to obovate-oblong, acute or obtuse; lateral sepals 1.7–2.5 mm. long and 1.2–1.5 mm. broad, ovate, acute or obtuse. Petals 0.5–0.7 mm. long and 0.4–0.5 mm. broad, suborbicular, apex truncate and thickened. Lip 0.6–0.75 mm. long and 0.3–0.6 mm. broad, rhombic to broadly ovate, thickened, excavate and concave in front, the basal half much thickened and the callus submammillate.

Costa Rica and Panama.

CHIRIQUÍ: between Alto de las Palmas and Cerro Horqueta, alt. 2100–2268 m., *Pittier 3228*.

The specimen cited is the largest known for the species and the maximum measurements apply to it.

4. STELIS MICROCHILA Schltr. in Fedde Rep. Sp. Nov. 9:289. 1911.

Stelis barbata Rolfe in Kew Bull. 1913: 141. 1913.
Stelis costaricensis Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:388. 1918.
Stelis cinerea Schltr. loc. cit. 444.
Stelis bryophila Schltr. in Fedde Rep. Sp. Nov. Beih. 19:16. 1923.

Small, caespitose, epiphytic herbs up to about 15 cm. tall. Secondary stems

up to about 2 cm. long, covered with one or more loose sheaths. Leaves 2–6 cm. long and 0.2–0.8 cm. broad, narrowly to broadly oblanceolate, obtuse or acute, attenuated into a narrow petiole at the base. Sepals connate for a short distance at the base, puberulent within and sometimes dorsally; dorsal sepal 1.5–2 mm. long and 1.3–1.5 mm. broad, ovate to suborbicular, obtuse or acutish; lateral sepals 1.2–1.5 mm. long and 1.1–1.3 mm. broad, broadly ovate. Petals about 0.75 mm. long and 0.75–1.1 mm. broad, transversely oblong or subquadrate, the truncate terminal margin thickened. Lip 0.5–0.6 mm. long and 0.25–0.4 mm. broad; basal ½ or ⅔ very fleshy, with two more or less longitudinal calluses or thickenings which have a distinct sinus; terminal lobe oblong or subquadrate, obtuse, cochleate, relatively thin.

Guatemala, Costa Rica, and Panama.

COCLÉ: mountains beyond La Pintada, alt. 400–600 m., *Hunter & Allen 590.*

5. STELIS MONTANA L. Wms. in Ann. Missouri Bot. Gard. 27:272. 1940; loc. cit. 29:340, *t. 32, figs. 9–12.* 1942.

Caespitose epiphytic herbs up to about 33 cm. tall. Secondary stems 11–13 cm. long, covered with the sheathing cauline bracts, shorter than the leaves. Leaves 17–20 cm. long and 3–3.5 cm. broad, oblanceolate, obtuse, coriaceous, gradually narrowed into a short petiole. Inflorescence racemose, as long as or longer than the subtending leaves. Sepals connate for a short distance at their bases. Dorsal sepal about 6 mm. long and 3.5 mm. broad, ovate to lanceolate-ovate, acute, apiculate. Lateral sepals about 5 mm. long and 4.5 mm. broad, broadly ovate, somewhat oblique, acute, apiculate. Petals about 1.5 mm. long and 1.5 broad, nearly orbicular, the apex thickened. Lip about 2–2.25 mm. long and 0.8–1 mm. broad, oblong to oblong-obovate, obscurely 3-lobed, the basal half filled with a large callus, the terminal part thin, minutely puberulent dorsally.

Endemic to Panama.

CHIRIQUÍ: trail from Cerro Punta to headwaters of Río Caldera, alt. 2250–2500 m., *Allen 1463.*

6. STELIS ATRORUBENS L. Wms. in Ann. Missouri Bot. Gard. 29:239. 1942.

Small, caespitose, epiphytic herbs up to about 18 cm. tall. Secondary stems 1.5–3.5 cm. long, slender, covered with bracts. Leaves 6–9 cm. long, petiolate, much longer than the secondary stems; lamina about 4–6.5 cm. long and 0.5–1 cm. broad, elliptic to elliptic-oblanceolate, obtuse, fleshy; petiole 2–3 cm. long. Inflorescence up to 15 cm. long, upper half more or less densely flowered; bracts about 2 mm. long, infundibuliform, acute, scarious. Sepals connate at the base, rotate, 2–2.5 mm. long and 1.5–2 mm. broad, triangular, acute, 3-nerved. Petals about 0.75 mm. long and 0.75 mm. broad, suborbicular, 1-nerved, the terminal part thickened, fleshy. Lip 1–1.5 mm. long and 0.5–0.6 mm. broad, obscurely 3-lobed, oblong or oblong-oval, basal part of the lip oblong, somewhat concave, fleshy, terminating into two small, suberect lateral lobes, terminal lobe of the lip about 0.5 mm. long, suborbicular, strongly concave, fleshy.

Fig. 82. *Stelis atrorubens*

Endemic to Panama.

COCLÉ: vicinity of El Valle, alt. 600–1000 m., *Allen 1234;* hills north of El Valle de Antón, trail to Las Minas, *Allen 2876.*

Allied to the preceding and the following species.

7. STELIS SKUTCHII Ames in Bot. Mus. Leafl. Harv. Univ. 6:17, *t.* 1938.

Caespitose epiphytic herbs up to 3 dm. tall. Secondary stems 6–10 cm. long, slender, covered with scarious sheaths. Leaves petiolate; lamina 5–12 cm. long and 0.8–2 cm. broad, elliptic, obtuse or acutish; petioles 2–4 cm. long, sulcate. Inflorescence up to 22 cm. long, exceeding the subtending leaf; bracts about 2 mm. long, infundibuliform. Sepals connate at the base, papilliferous within; dorsal sepal about 6 mm. long and 2 mm. broad, lanceolate-ovate, apiculate; lateral sepals about 4.5 mm. long and 2 mm. broad, ovate-lanceolate, slightly oblique. Petals about 1 mm. long and about 1.3 mm. broad, flabellate, callus-thickened toward the truncate apex. Lip about 1 mm. long and 0.5 mm. broad, linguiform, with an erect but obscure lobule on each side near the middle, callus-thickened below, terminal part slightly concave above and slightly narrower than the basal portion.

Costa Rica and Panama.

CHIRIQUÍ: Bajo Chorro, Boquete District, alt. 6000 feet, *Davidson 270.*

Fig. 83. *Stelis Skutchii*

8. STELIS HYMENANTHA Schltr. in Fedde Rep. Sp. Nov. 10. 291. 1912.

Stelis cuspidilabia Schltr. in Fedde Rep. Sp. Nov. Beih. 19:17. 1923.
Stelis seleniglossa Schltr. loc. cit. 97.

Small, caespitose, epiphytic herbs up to about 20 cm. long. Secondary stems 1–5 cm. long, shorter than the leaves. Leaves 4–10 cm. long and 0.2–1 cm. broad, linear, ligulate to oblanceolate, obtuse or acute, coriaceous. Inflorescence up to 13 cm. long, longer than or subequal to the subtending leaves. Sepals 1–1.4 mm. long and 0.75–1.2 mm. broad, broadly oval to suborbicular, obtuse or acute, free almost to their bases. Petals about 0.5 mm. long and 0.25–0.3 mm. broad, oblong, truncate, apex thickened. Lip 0.5–0.7 mm. long and about 0.4 mm. broad, subquadrate to suborbicular-ovate, the apex produced into a broad, acute or acuminate apicule about ⅓ the length of the lip, disc provided with a bipartite callus on the basal half.

Mexico, Guatemala, Costa Rica and Panama.

CHIRIQUÍ: Bajo Chorro, alt. 6000 feet, *Terry 1286.*

9. STELIS CRESCENTIICOLA Schltr. in Fedde Rep. Sp. Nov. 16:442. 1920; Ames, Sched. Orch. 5:11. 1923; Ames in Bot. Mus. Leafl. Harv. Univ. 3:175, *t.* 1935.

Stelis flexuosa Lindl., sensu Kränzl., in Engl. Bot. Jahrb. 26:450. 1899.
Stelis Isthmii Schltr. in Fedde Rep. Sp. Nov. Beih. 17:16. 1922.
Stelis praemorsa Schltr. loc. cit. 17.

Small, caespitose, epiphytic herbs up to 20 cm. tall. Secondary stems 1–2 cm. long, slender, much shorter than the leaves. Leaves 4–9.5 cm. long and 0.5–1 cm. broad, oblanceolate, acute or obtuse, attenuated into a petiole at the base, coriaceous. Inflorescence up to about 18 cm. long, much exceeding the leaves, raceme densely flowered; bracts 1–2 mm. long, infundibuliform. Sepals 1–1.5 mm. long and 1–1.5 mm. broad, suborbicular to subrhombic-ovate, acute or obtuse, papilliferous within. Petals about 0.5 mm. long and about 0.75 mm. broad, flabellate, not thickened at the apex. Lip about 0.5 mm. long and 0.5 mm. broad and nearly as thick, rhombic-ovate, with a transverse callus through the middle and the short apex incurved.

Costa Rica and Panama.

CANAL ZONE (?): in tidal belt, *Pittier 6595.* PANAMÁ: Río Chagres, *Lehmann 4540;* hills east of [Panamá] City and San Juan, all near sea-level, *Powell 232, 234, 284, 285, 3312, 3313, 3314, 3522.*

The smallest-flowered of the Panamanian species.

10. STELIS LEUCOPOGON Reichb. f. Beitr. Orch. Centr.-Am. 95, *t. 9, figs. I, 1-4.* 1866.

Stelis cascajalensis Ames, Sched. Orch. 4:11. 1923.
Stelis eximia Ames, loc. cit. 6:54. 1923.

STELIS *crescentiicola* Schltr.

Fig. 84

Caespitose epiphytic herbs up to about 40 cm. tall. Secondary stems 2–15 cm. long, either longer or shorter than the leaves. Leaves 6–15 cm. long and 1–4.5 cm. broad, ligulate, oblanceolate to narrowly oval, acute or obtuse, coriaceous, attenuated into a petiole at the base. Inflorescence up to 30 cm. long, one or more from the apex of each secondary stem, subequal to usually much exceeding the leaves in length. Sepals 4–9 mm. long and 4–8 mm. broad, broadly ovate-triangular to suborbicular, acute or obtuse, puberulent or glabrous within, usually 5-nerved. Petals 0.75–1.3 mm. long and 1.75–2.2 mm. broad, flabellate, truncate apex very fleshy. Lip 0.5–1 mm. long and 0.7–1.2 mm. broad, transversely oblong to suborbicular-quadrate, apiculate or triapiculate at the apex, disc very fleshy, the callus more or less transverse.

Costa Rica and Panama; possibly also in South America.

CHIRIQUÍ: vicinity of Bajo Chorro, alt. 1900 m., *Woodson & Schery 624;* "Caramilla," alt. 4000–6000 feet, *Powell 312, 334.* COCLÉ: hills north of El Valle de Antón, alt. 1000 m., *Allen 2173;* vicinity of La Mesa, north of El Valle de Antón, alt. about 1000 m., *Allen 2301;* north rim, El Valle de Antón, *Alston & Allen 1840.*

A variable species which may include *Stelis Endresii* Reichb. f. The specimens from Coclé differ somewhat from the others in having a triapiculate apex on the lip.

11. STELLIS ENDRESII Reichb. f. in Gard. Chron. 1373. 1870; Ames in Bot. Mus. Leafl. Harv. Univ. 1⁹: *fig. p. 9.* 1933.

Stelis parvibracteata Ames, Orch. 7:131. 1922.

Small, caespitose, epiphytic herbs up to 22 cm. tall. Secondary stems 1.5–5 cm. long, slender, shorter than the leaves. Leaves 4–13 cm. long and 0.5–2 cm. broad, elliptic to oblanceolate, obtuse or acute, attenuated into a petiole at the base. Inflorescence up to 18 cm. long, floriferous to the middle or below, much exceeding the leaves, 1 or more from a stem; bracts 1–2 mm. long, infundibuliform. Sepals 2–4 mm. long and 2–5 mm. broad, suborbicular to subtriangular, acute or obtuse, glabrous to puberulent within, 2-(or rarely 5-) nerved. Petals 0.75–1 mm. long and 1–1.5 mm. broad, flabellate, truncate, apical part thickened and fleshy. Lip about 0.75 long and 1 mm. broad, transversely oval, with a small, erect apicule at the apex.

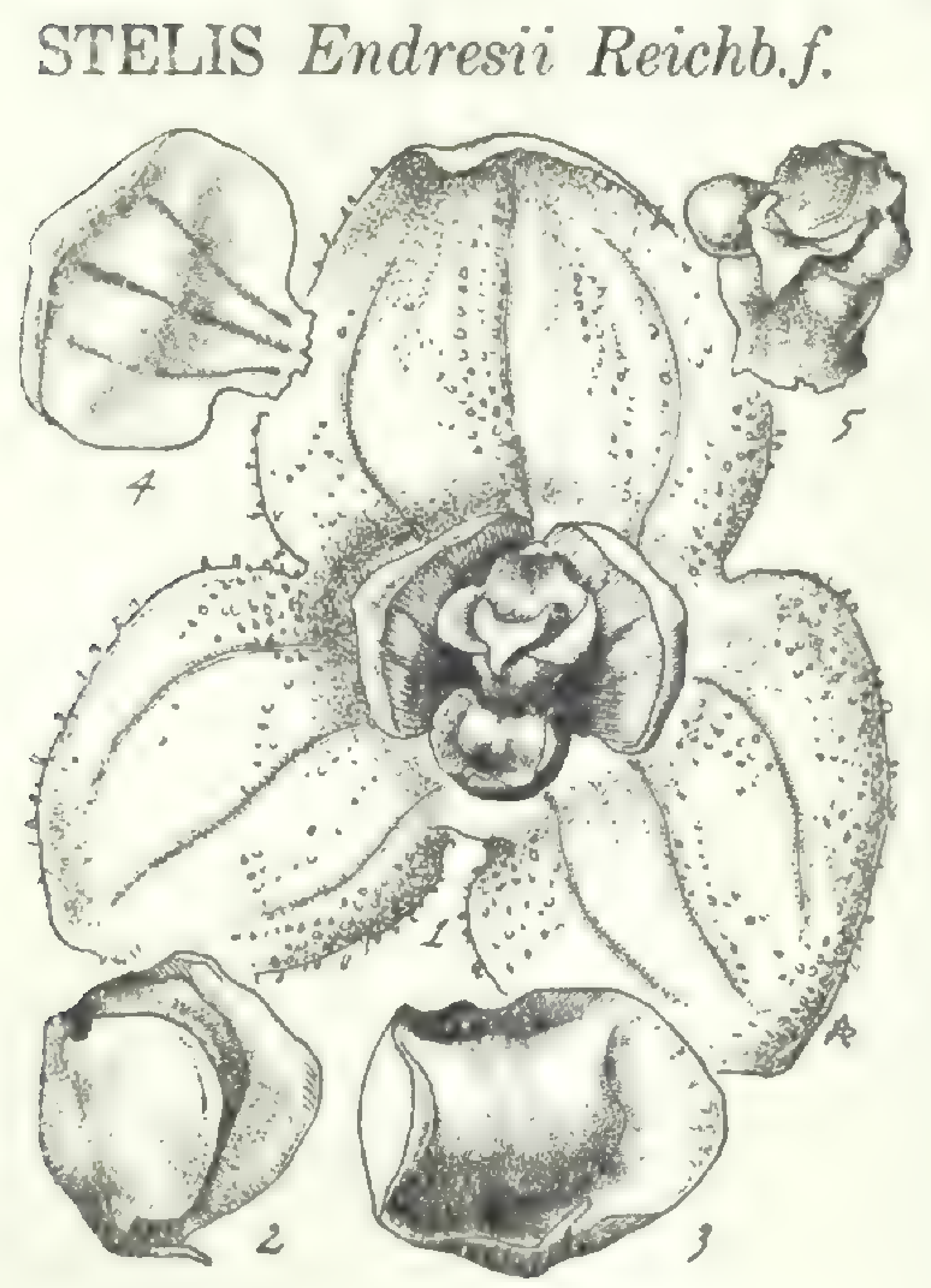


Fig. 85

Mexico, Guatemala, Costa Rica and

Panama, possibly also in South America.

DARIÉN: Cana and vicinity, alt. 6000 feet, *Williams 972*. COCLÉ: hills north of El Valle de Antón, alt. 800–1000 m.. *Allen 2273*.

Critical work on the genus may prove this species to be the same as S. *leucopogon* Reichb. f.

12. STELIS POWELLII Schltr. in Fedde Rep. Sp. Nov. Beih. 17:16. 1922; Ames in Bot. Mus. Leafl. Harv. Univ. 1^9: *fig. p. 9.* 1933.

STELIS *Powellii Schltr.*

Fig. 86

Small, caespitose, epiphytic herbs up to 15 cm. tall. Secondary stems 1–3 cm. long, shorter than the leaves. Leaves attenuated into a petiole at the base; lamina 2–7 cm. long and 0.5–1.5 cm. broad, oblanceolate to ligulate-oblanceolate, obtuse; petiole up to 3 cm. long. Inflorescence longer than the leaves; bracts 2–4 mm. long, ovate, acute, large and conspicuous for the genus, infundibuliform. Sepals 2.5–3 mm. long and 3–3.5 mm. broad, connate for a short distance at the base, suborbicular to ovate-suborbicular or ovate-triangular, obtuse, 5-nerved, puberulent or papillose within. Petals 1–1.5 mm. long and 1.5–2 mm. broad, flabellate, subtruncate and thickened terminally. Lip 1.2–1.5 mm. long and 0.75–1.2 mm. broad, ovate, concave, relatively thin with a cruciform callus in the middle.

Costa Rica and Panama.

CHIRIQUÍ: alt. 4000 feet, *Powell 247*.

Conspicuous among Panamanian species by the relatively conspicuous bracts.

13. STELIS STORKII Ames in Bot. Mus. Leafl. Harv. Univ. 3:54, *fig.* 1935; L. Wms. in Ann. Missouri Bot. Gard. 27:273. 1940.

Small, caespitose, epiphytic herbs up to 6 cm. tall. Secondary stems 1–2 cm. long, covered with sheathing bracts, shorter than the leaves. Leaves 1–4 cm. long and 0.25–0.5 cm. broad, oblanceolate, acute or obtuse, inconspicuously marginate, longer than the secondary stems, equal to or usually shorter than the inflorescence. Inflorescence up to about 4 cm. long; bracts 1–1.5 mm. long, infundibuliform, apiculate. Sepals connate for a short distance at their bases, 1–1.3 mm. long and 1–1.3 mm. broad, nearly orbicular, obtuse, 3-nerved. Petals 0.5–0.75 mm. long and about 0.6 mm. broad, broadly obovate or cuneate-

flabellate, slightly cochleate, the apex thickened. Lip about 0.5–0.75 mm. long and as broad, nearly orbicular, fleshy, with a large central callus extending through the middle of the lamina and prominently raised at the base.

Costa Rica and Panama.

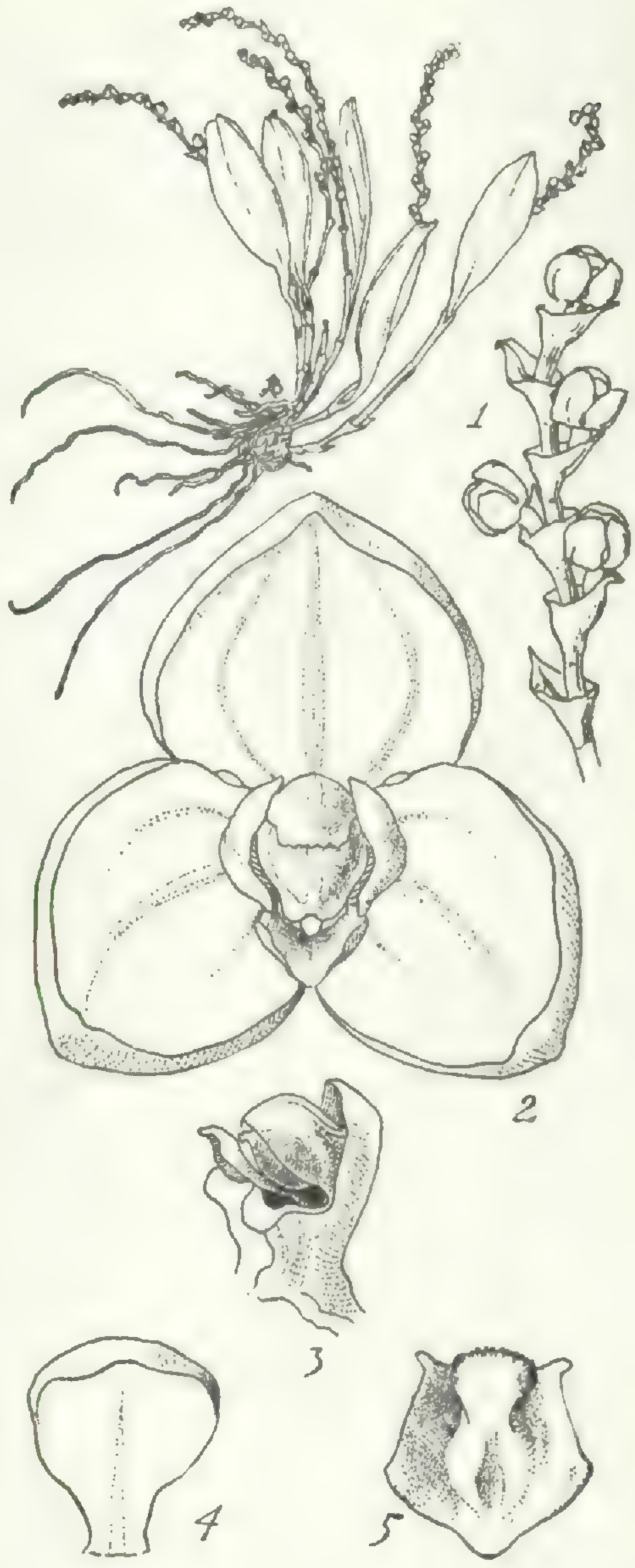
COCLÉ: vicinity of El Valle, alt. 800–1000 m., *Allen 1828.*

14. STELIS MAXONII Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:389. 1918.

Caespitose epiphytic herbs up to 40 cm. tall. Secondary stems up to 23 cm. long, slender. Leaves 9–15 cm. long and 1–2.7 cm. broad, elliptic to lanceolate, obtuse, coriaceous, attenuated into a short petiole at the base. Inflorescence up to about 15 cm. long, subequal to the leaves; bracts about 3 mm. long, infundibuliform, acute or shortly acuminate. Sepals 2–3 mm. long and 2.2–3.5 mm. broad, suborbicular. Petals about 1 mm. long and 1 mm. broad, suborbicular, flabellate, the terminal part thickened and fleshy. Lip about 1.2 mm. long and 1 mm. broad, broadly oval in outline, with a transverse callus across the middle of the lip, the lip fleshy.

Costa Rica and Panama.

CHIRIQUÍ: Volcán de Chiriquí, alt. 10,000 feet, *Davidson 988;* above El Boquete, alt. 1450–1650 m., *Maxon 5697;* southern slope of La Horqueta, alt. 1700–2100 m., *Pittier 3242.*



STELIS *Storkii Ames*

Fig. 87

Closely allied to S. *thecoglossa* Reichb. f. with which it has been placed.

15. STELIS PANAMENSIS Schltr. in Beih. Bot. Centralbl. 37, Abt. 2:391. 1918.

Erect epiphytic herbs up to 18 cm. tall. Secondary stems 2–3 cm. long, much shorter than the leaves. Leaves 8–10 cm. long and 0.8–1 cm. broad, oblanceolate-ligulate, obtuse, narrowed to a petiole at the base. Inflorescence equal to the leaves or shorter; bracts cucullate. Sepals broadly ovate, obtuse; dorsal sepal about 2.5 mm. long; the lateral sepals distinctly smaller, oblique. Petals broadly rhombic-reniform, oblique, obtuse, apex thickened. Lip subequal to the petals, reniform, obtuse, excavated at the base and the middle with a transverse callus.

Panama.

PANAMÁ: forests of the upper Mamoni River, alt. 150–400 m., *Pittier 4490*.

This species is known to us only by the description and an analysis of the type.

STELIS *vestita Ames*

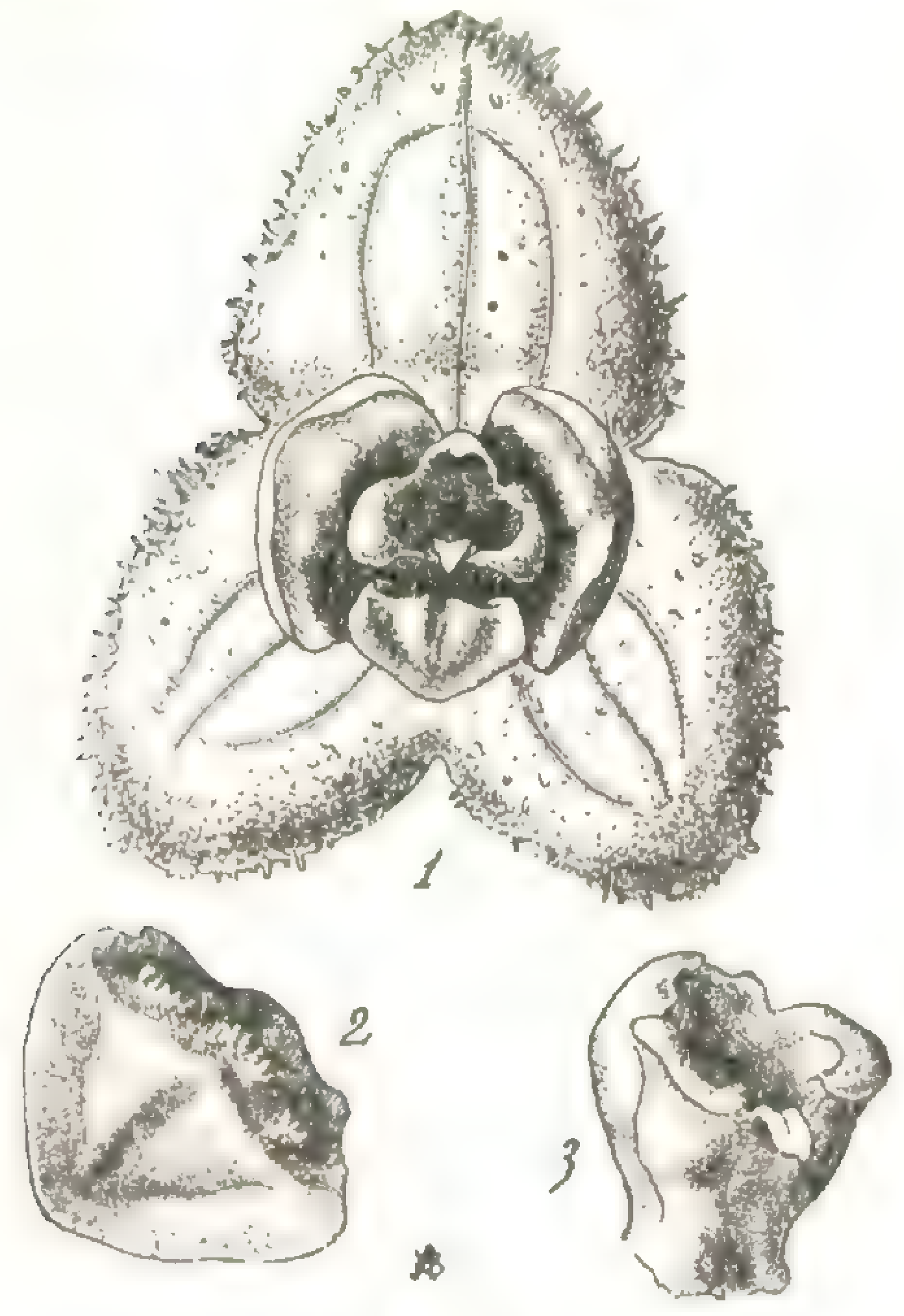


Fig. 88

16. STELIS VESTITA Ames, Sched. Orch. 6:56. 1923; in Bot. Mus. Leafl. Harv. Univ. 1^{9}: *fig. p. 9.* 1933.

Caespitose epiphytic herbs up to 45 cm. tall. Secondary stems 4–10 cm. long, subequal or shorter than the leaves. Leaves 5–16 cm. long and 1–2 cm. broad, elliptic-oblong to oblanceolate, attenuated into a petiole at the base, coriaceous. Inflorescence up to about 35 cm. long, much longer than the subtending leaf; bracts 2–3 mm. long, infundibuliform. Sepals 2–2.5 mm. long and 2–2.3 mm. broad, ovate to suborbicular, obtuse, densely glandular-pubescent within. Petals 0.8–1 mm. long and 1.5–1.75 mm. broad, cuneate-flabellate, fleshy, truncate. Lip 0.8–1 mm. long and 1–1.2 mm. broad, suborbicular or transversely subrhombic, callus-thickened in the middle and the basal part with a smaller spongy callus, the margins of the lip thin.

Costa Rica and Panama.

CHIRIQUÍ: Boquete, alt. 4000 feet, *Davidson 696*.

Allied to S. *Endresii* Reichb. f. and to S. *leucopogon* Reichb. f.

17. STELIS AEMULA Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:385. 1918.
Stelis sarcodantha Schltr. loc. cit. 392.

Small, caespitose, epiphytic herbs up to about 2.5 cm. tall. Secondary stems 1.5–7.5 cm. long, slender, shorter than the leaves. Leaves 4–11.5 cm. long and 0.5–1.3 cm. broad, ligulate to oblanceolate, obtuse or acute, coriaceous, attenuate at the base into a petiole. Inflorescence up to 20 cm. long (in Panama mostly 12 cm. or less), much exceeding the leaves; bracts 1–2 mm. long, infundibuliform. Sepals 1.5–2.2 mm. long and 1.75–2.5 mm. broad, broadly ovate-orbicular or suborbicular, obtuse or acutish, marginate or the margins obscurely involute, puberulent or glabrous within. Petals 0.5–0.6 mm. long and 0.6–1 mm. broad, oblong to flabellate, the apex thickened. Lip 0.5–0.75 mm. long and 0.6–1 mm. broad, suborbicular, obtuse, with a transverse callus in the middle, margins not thickened.

(Guatemala, Honduras — S. *perplexa* Ames)?, Costa Rica, and Panama.

CHIRIQUÍ: Palo Alto, alt. 4500–5000 feet, *Powell 290, 291, 293, 294.* COCLÉ: hills north of El Valle de Antón, alt. 1000 m., *Allen 2154, 2157.*

18. STELIS COLLINA Schltr. in Fedde Rep. Sp. Nov. Beih. 17:15. 1922.

Small, caespitose, epiphytic herbs up to 28 cm. long. Secondary stems up to 3 cm. long, slender. Leaves 3–10 cm. long and 0.7–1.2 cm. broad, oblanceolate-ligulate, obtuse, attenuated into a petiole at the base. Inflorescence elongated, much exceeding the leaves; bracts about 2 mm. long, infundibuliform. Sepals 3–3.5 mm. long and 3–3.5 mm. broad, triangular-ovate, obtuse, 3-nerved. Petals about 1 mm. long and 1.5 mm. broad, flabellate, truncate apex thickened. Lip about 0.8 mm. long and 1 mm. broad, suborbicular, obtuse, with a transverse raised callus in the middle, the basal half with two lateral cavities and a small longitudinal ridge between them.

Panama.

PANAMÁ: foot-hills near [Panamá] City, near sea-level, *Powell 180.*

Formery referred to S. *Williamsii* Ames, but probably distinct, though closely allied.

19. STELIS WILLIAMSII Ames, Orch. 7:133. 1922.

Small, caespitose, epiphytic herbs up to 25 cm. tall. Secondary stems about 1.5 cm. long. Leaves 4–10 cm. long and 0.6–1.1 cm. broad, attenuated into a short petiole at the base, oblanceolate-ligulate. Inflorescence up to 23 cm. long, much exceeding the leaves; bracts 2–5 mm. long, infundibuliform, free part triangular-lanceolate or broadly ovate, acute or acuminate. Sepals about 3.5–4.5 mm. long and as broad, suborbicular, obtuse. Petals about 1.5 mm. long and 1.7 mm. broad, cuneate-flabellate. Lip about 1 mm. long and 1.2 mm. broad, trulliform, obtuse, with a raised transverse callus.

Panama.

DARIÉN: Cana and vicinity, alt. 6000 feet, *Williams 970.*

Has been confused with S. *collina* Schltr., a closely allied sea-level species.

20. STELIS LONGIPETIOLATA Ames, Sched. Orch. 1:6. 1922.

Small, caespitose, epiphytic herbs up to 10 cm. tall. Leaves 4.5–8 cm. long and 0.7–1.1 cm. broad, elliptic, petiolate, the lamina up to 5.5 cm. long. Secondary stems 1.5–2.5 cm. long, slender, much shorter than the leaves. Inflorescence about equalling the leaves in length; bracts about 1.5 mm. long, infundibuliform. Sepals 2–2.5 mm. long, rotate, deltoid-ovate. Petals about 1 mm. long, ovate to suborbicular, thickened nearly to the base, abruptly excavated below the thickening, apex obscurely and minutely papillose. Lip about 0.75 mm. long and 1.5 mm. broad, reniform, very fleshy, somewhat concave above with a prominent and obscurely bilobed callus in the middle, the sides of which are decurrent laterally

and form a transverse ridge.

Panama.

CHIRIQUI: humid forest between Alto de las Palmas and Cerro de la Horqueta, alt. 2100–2200 m., *Maxon 5460*.

17. PHYSOSIPHON Lindl.

PHYSOSIPHON Lindl. in Bot. Reg. 21: sub *t. 1797*. 1836.

Small, caespitose, epiphytic herbs. Secondary stems slender, terminated by a single leaf. Sepals connate at the base into an (usually) inflated tube, free above, erect or spreading, not caudate. Petals very small in comparison to the sepals. Lip small, articulated to the column-foot, entire or three-lobed. Anther terminal, incumbent, operculate; pollinia 2, ceraceous.

A small genus of rather diverse species, of which the Panama one is not typical of the genus.

1. PHYSOSIPHON MINUTIFLORUS Ames & Schweinf. Sched. Orch. 8:11, *t. 22, figs. 1-6 and habit.* 1925.

Small caespitose epiphytic herbs up to 30 cm. tall. Secondary stems 2–10 cm. long, invested by 2–3 loose sheaths. Leaves 3.5–12 cm. long and 0.5–1.5 cm. broad, oblong-ligulate, coriaceous, attenuated at the base into a petiole. Inflorescence up to 25 cm. long, equalling or exceeding the leaves, densely flowered almost to the base; bracts 2–3 mm. long, infundibuliform. Sepals connate into a short tube at the base, 2–3 mm. long and about 0.6–0.8 mm. broad, free portion ovate-lanceolate, acute or obtuse. Petals about 0.75 mm. long and about 0.2 mm. broad, lanceolate, acute or obtuse. Lip about 0.75 mm. long and 0.75 mm. broad, ovate-quadrate to suborbicular, apiculate.

Costa Rica and Panama; possibly Honduras.

CHIRIQUÍ: Cerro Vaca, alt. 900–1136 m., *Pittier 5340;* "Caramillo," alt. 5000 feet, *Powell 345*.

18. CRYPTOPHORANTHUS Barb. Rodr.

CRYPTOPHORANTHUS Barb. Rodr. Gen. & Sp. Orch. Nov. 2:79. 1882; Kränzl. in Fedde Rep. Sp. Nov. Beih. 34:220-232. 1925.

Small epiphytic herbs, the secondary stem terminated by a single leaf. Inflorescence short, 1-flowered or with a fascicle of flowers. Sepals connate at the base and at the apices, leaving an opening ("window") on either side between the dorsal and lateral sepals, the lateral sepals forming a mentum at the base. Petals small in comparison to the sepals. Lip free, simple, obscurely lobed or hastate, with two parallel lamellae, subequal to the petals in length. Column small, terete, erect or arcuate, produced into a short foot at the base. Anther terminal, operculate, incumbent; pollinia 2, ceraceous.

Fig. 89. *Physosiphon minutiflorus*

A small genus closely allied to *Masdevallia* and *Pleurothallis*. There are three or four species in Costa Rica and one in Panama.

1. Cryptophoranthus lepidotus L. Wms. in Ann. Missouri Bot. Gard. 29:340, *t. 30, figs. 4-5.* 1942.

Caespitose epiphytic herbs up to about 17 cm. tall. Secondary stems 2–7 cm. long and 1–2 mm. in diameter, covered with 4–5 pergameneous, infundibuliform sheaths which soon disentegrate. Leaves oblanceolate to narrowly obovate, obtuse or acutish, coriaceous, contracted into a distinct petiole; lamina 3.5–10 cm. long; petiole 1–2 cm. long, conduplicate. Inflorescence consisting of 1–6 long-pedunculate flowers at the apex of the secondary stem; the peduncle with 1–3 short infundibuliform sheaths. Sepals joined together at the base and at the tip, leaving

Fig. 90. *Cryptophoranthus lepidotus*

a small opening between the dorsal and lateral ones; dorsal sepal about 15–20 mm. long and 6–7 mm. broad, oblong-lanceolate, strongly cucullate, fleshy, 7-nerved, ridged dorsally and the ridges verrucose; lateral sepals connate to their apices, about 12–18 mm. long and together 6–8 mm. broad, fleshy, each about 7-nerved, with verrucose ridges dorsally. Petals 5–6 mm. long and 2.5–3.5 mm. broad, broadly ovate-lanceolate, acute or acuminate, 3-(5-)nerved. Lip 5–6 mm. long, hastate, unguiculate; lamina about 4 mm. long, 1.5–2 mm. broad, 3-nerved, verrucose or lepidote, with two longitudinal, lamellate calluses extending from the auricles to about the middle; auricles about 1 mm. long, retrorse, subulate; claw 1.5–2 mm. long and 1–1.5 mm. broad, verrucose-scurfy or lepidote toward

its apex. Column of the genus.

COCLÉ: trail to Las Minas, hills north of El Valle de Antón, alt. about 1000 m., *Allen 2718.*

19. MASDEVALLIA Ruiz & Pavon

MASDEVALLIA Ruiz & Pavon, Fl. Peruv. & Chil. Prodr. ed. 1, 122. 1794; ed. 2, 110, *t. 27.* 1797; Woolward, Genus Masdevallia. 1896; Kränzl. in Fedde Rep. Sp. Nov. Beih. 34:1-202. 1925.

Caespitose or repent, epiphytic or terrestrial herbs. Secondary stems usually very short, bearing a single leaf and a peduncle or the leaves and peduncles borne on separate stems. Leaves most often broadest toward the apex and attenuated into a petiole at the base, with an abscission at the end of the secondary stem and another slightly above. Peduncles usually 1- to 2-flowered. Sepals connate into a tube at the base or to the middle or beyond, the free portions often spreading, the tips usually developed into slender tails, produced into a mentum at the base. Petals very much smaller than the sepals, usually narrow. Lip small, articulated to the column-foot, about as long as the column. Column erect, produced into a column-foot at the base; margins of the clinandrium usually membranaceous and denticulate. Anther terminal, operculate, incumbent; pollinia 2, ceraceous.

A large and complex genus of some 250 species. The species are most abundant in cool mountain regions of the tropics of the New World. The genus was once very popular with orchid fanciers, some of the rarer or more beautiful species commanding fabulous prices.

Masdevallia connects to the genus *Pleurothallis* at several points, notably through such species as *M. Allenii* L. Wms., which differs but slightly from the species of Schlechter's *Barbosella* (previously reduced to *Pleurothallis*). *Scaphosepalum* has several species which are "connecting links" between *Masdevallia* and *Pleurothallis*. Lindley's genus *Restrepia*, which I have reduced to *Pleurothallis*, contains some intermediate species between *Pleurothallis* and *Masdevallia*, and if *Restrepia* were to be maintained as a genus most of the species which were referred to *Barbosella* and many of the species of *Masdevallia* § *Triaristella* (*M. triaristella* Reichb. f., *M. Allenii* L. Wms., etc.) should be placed there. There is little or no technical reason why *Pleurothallis* (and *Stelis* too) should not be reduced to *Masdevallia*, but it would serve no practical purpose to do so. *Pleurothallis* and *Masdevallia* are both large and technical and *most* of the species can be placed in the proper genus readily.

a. Tails of the lateral sepals originating below the apex .... 8. M. ALLENII
aa. Tails of the lateral sepals, if present, terminal.
  b. Lateral sepals with transverse calluses at the base .... 7. M. SIMULA
  bb. Lateral sepals without transverse calluses at the base.
    c. Callus at the base of the petal free and appearing to be a cauda.... 1. M. COLLINA
    cc. Callus lacking at the base of the petal, or if present not free.
      d. Lip less than 2.5 mm. long .... 6. M. TENUISSIMA
      dd. Lip more than 2.5 mm. long.

e. Dorsal sepal prolonged into a subfiliform tail.
f. Peduncle usually 2-flowered, about as long as the leaves or longer; lip up to 4 mm. long .... 3. M. CHONTALENSIS
ff. Peduncle 1-flowered, always shorter than the leaves; lip more than 4 mm. long .... 2. M. ATTENUATA
ee. Dorsal sepal either without tails, or with tails not filiform.
f. Free part of the dorsal sepal lanceolate or lanceolate-ovate, erect .... 4. M. ECAUDATA
ff. Free part of the dorsal sepal ligulate or lanceolate-ligulate, recurved .... 5. M. LIVINGSTONEANA

1. MASDEVALLIA COLLINA L. Wms. in Am. Orchid Soc. Bull. 11:93, *t. 3.* 1942.

Small caespitose epiphytic herbs up to 15 cm. tall. Secondary stems very short, bearing a leaf and an inflorescence. Leaves 6–9 cm. long and 1.1–1.5 cm. broad, oblanceolate, obtuse, attenuated into a petiole at the base, coriaceous, 3-nerved. Inflorescence slender, (1?–) 2-flowered, peduncle much exceeding the leaves. Sepals about 25 mm. long, connate into a tube for about ½ their length; tube 11–14 mm. long, free part of the sepals 9–14 mm. long, consisting of subfiliform caudae from a very short free lamina. Petals about 4 mm. long and 1.5 mm. broad, linear-oblong, truncate and tridentate at the apex, 1-nerved, with an elongated, sublamellate callus which extends from near the base to near the apex along the anterior margin; another callus begins near the base and extends to and off at the base forming a free, curved, cauda-like process, the free part about 1 mm. long. Lip about 6 mm. long and 2 mm. broad, linear-oblong, truncate and retuse at the base, the apex rounded, somewhat dilated and ciliate, fleshy, somewhat canaliculate, keeled on the mid-nerve below.

Panama.

COCLÉ: hills north of El Valle de Antón, alt. about 1000 m., *Allen 2158.*

2. MASDEVALLIA ATTENUATA Reichb. f. in Gard. Chron. 834. 1871; Woolw. Genus Masdevallia *t.* [*35*]. 1896; Hook. f. in Bot. Mag. 33: *t. 6273.* 1877.

Masdevallia Laucheana Kränzl. ms. ex Woolw. loc. cit. *t.* [*19*]; Kränzl. in Fedde Rep. Sp. Nov. Beih. 34:166. 1925.

Small, caespitose, epiphytic herbs up to about 15 cm. tall. Secondary stems very short. Leaves 5–13 cm. long and 0.5–1.8 cm. broad, linear-oblanceolate to oblanceolate, acute or obtuse, attenuated into a petiole at the base. Inflorescence 1-flowered; peduncles slender, shorter than the leaves. Sepals 18–22 mm. long, connate into a tube for about ⅓ their length, the caudate apices about as long as the broad part of the sepals, puberulent within, the broad, free part of the sepals oblong-ovate to triangular-ovate. Petals 3.5–5 mm. long and 1.2 mm. broad, subrhombic to oblong-lanceolate, acute, somewhat oblique, with a longitudinal callus along one margin. Lip 4.2–5 mm. long and 1.5–2 mm. broad, oblong-lanceolate to oblong-pandurate, obtuse or acute, apical portion denticulate, with two longitudinal keels which converge toward the apex.

Costa Rica and Panama.

CHIRIQUÍ: Boquete, alt. about 1360 m., *Davidson 1271;* "Chiriquí," *Pfau;* "Cerro Horconcito," alt. about 1360 m., *Powell 268.*

Fig. 91. *Masdevallia collina*

Possibly the original collection of this species was from Chiriquí *(Pfau)*, Powell's collection differs slightly from the others. The species is rare and more specimens are desired for study.

3. MASDEVALLIA CHONTALENSIS Reichb. f. in Otia Bot. Hamb. 1:274. 1878; L. Wms. in Ann. Missouri Bot. Gard. 27:274. 1940.

Masdevallia diantha Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:384. 1918.

Small, caespitose, epiphytic herbs up to about 11 cm. tall. Secondary stems up to about 2 mm. long. Leaves 2–9 cm. long and 0.2–0.8 cm. broad, oblanceolate to linear-oblanceolate, acute or obtuse, attenuated into a petiole at the base. Inflorescence 1- or usually 2-flowered; peduncles from almost as long as the leaves to twice as long. Sepals 9–18 mm. long, connate into a tube for about ½ or ⅗ their length, the free part ovate to ovate-lanceolate and caudate. Petals 2.5–3.5 mm. long and 0.7–1.2 mm. broad, linear-oblong to oblong-lanceolate, apex tridentate, truncate or obtuse, with a small lateral callus extending from about the middle toward the apex. Lip 2.8–4 mm. long and 0.9–1.7 mm. broad, oblong-oblanceolate to oblong-obovate, biauriculate at the base, with two longitudinal callus-ridges extending from the base nearly to the apex where they converge, dilated apical part denticulate.

Nicaragua, Costa Rica and Panama.

COCLÉ: vicinity of El Valle, alt. 600–1000 m., *Allen 1231;* vicinity of El Valle, north rim, alt. 800–1000 m., *Allen 1826;* trail to Las Minas, El Valle de Antón, alt. 1000 m., *Allen 2876.*

4. MASDEVALLIA ECAUDATA Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:384. 1918; L. Wms. in Ann. Missouri Bot. Gard. 27:274. 1940.

Small, caespitose, epiphytic herbs up to about 12 cm. tall. Secondary stem short, 2–10 mm. long. Leaves 3–9 cm. long and 0.6–1.1 cm. broad, oblanceolate, obtuse, coriaceous, attenuated into a petiole at the base. Inflorescence about as long as or exceeding the leaves, 1-flowered, the peduncle slender. Sepals puberulent within, about 15–22 mm. long, connate into a tube about ⅔ of their length, the free parts lanceolate to ovate-lanceolate, acute or acuminate, usually ecaudate but sometimes caudate, the apices thickened. Petals 5–8 mm. long and 1.5–3.5 mm. broad, oblong-ovate, short-unguiculate, usually angled on one side. Lip 6.5–9 mm. long and 2–3.5 mm. broad, oblong-lanceolate, auriculate at the base, disc with a pair of longitudinal fleshy calli.

Costa Rica and Panama.

CHIRIQUÍ: valley of the upper Río Chiriquí Viejo, *White & White 81.*

Very closely allied to *M. Livingstoneana*, from which it differs mainly in having slightly different sepals and petals and a larger lip.

5. MASDEVALLIA LIVINGSTONEANA Reichb. f. in Gard. Chron. II, 2:322. 1874; Ames, Sched. Orch. 5:9, *fig. 2.* 1923.

Scaphosepalum panamense Schltr. in Fedde Rep. Sp. Nov. 12:205. 1913.
Masdevallia panamensis Ames, Sched. Orch. 4:9. 1923.

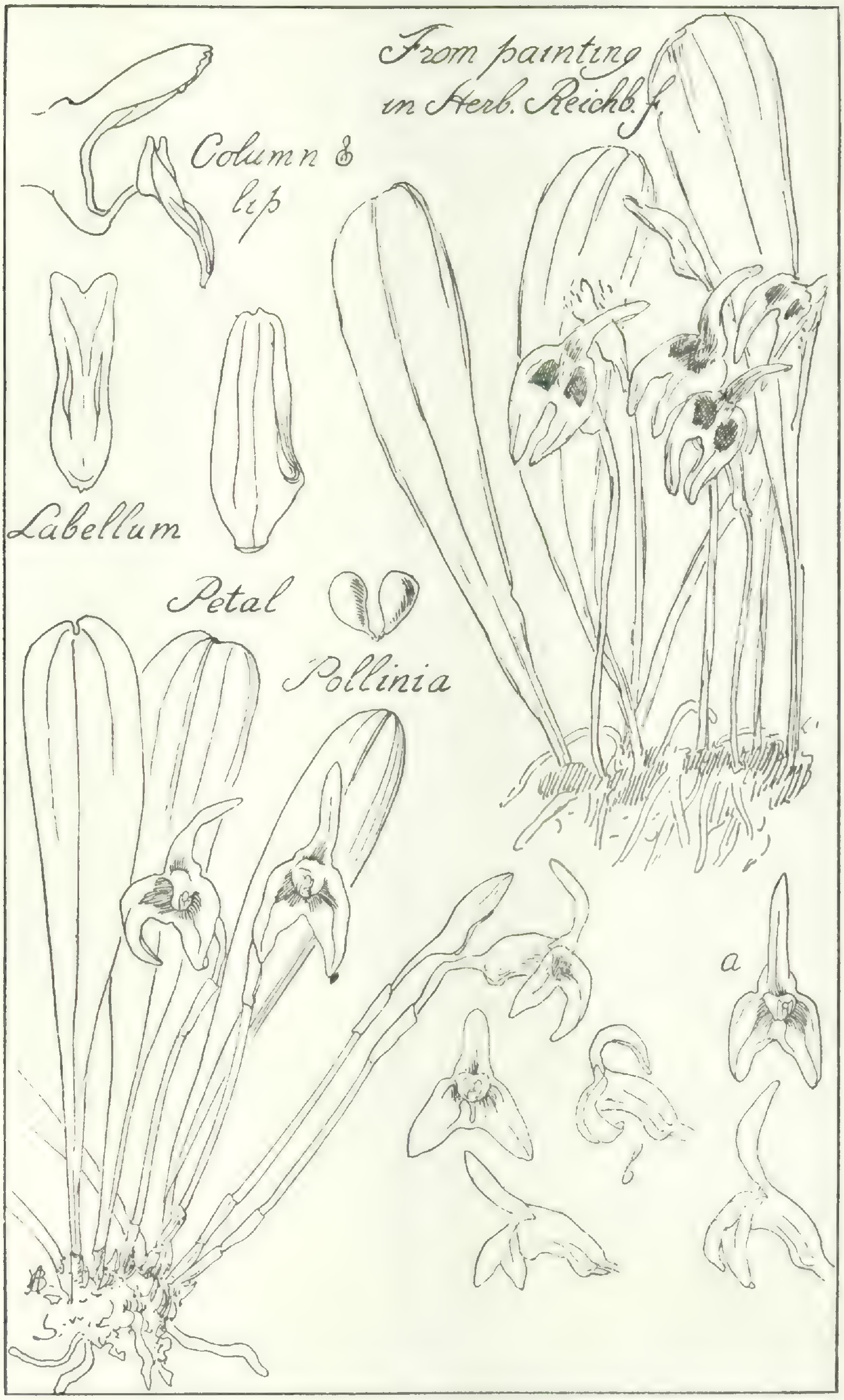


Fig. 92. *Masdevallia Livingstoneana*

Small, caespitose, epiphytic herbs up to 13 cm. tall. Secondary stems short. Inflorescence 1-flowered, peduncle shorter than the leaves. Sepals 15–20 mm. long, connate into a tube for about ½ their length; free portion of dorsal sepal up to 12 mm. long and 3 mm. broad at the base, ligulate or lanceolate-ligulate,

somewhat thickened and fleshy toward the apex; free part of the lateral sepals up to 12 mm. long and 5 mm. broad, lanceolate-triangular, arcuate, acute or obtuse. Petals 4.5–5 mm. long and 1.5–2 mm. broad, oblong, obtuse, with a single longitudinal sublamellate callus extending from below the middle to the apex. Lip 4–6 mm. long and 1–1.2 mm. broad, oblong to oblong-lanceolate, acute or obtuse, sometimes more or less pandurate, the disc thickened and with two raised, longitudinal calli.

Costa Rica (?) and Panama.

CANAL ZONE: forest along Río Indio de Gatún, alt. near sea-level, *Pittier 2803;* west of canal near village of Arraján, alt. near sea-level, *Powell 223.* PANAMÁ: foothills east of Panama City and San Juan, alt. near sea-level, *Powell 273, 411, 3282, 3287.*

6. MASDEVALLIA TENUISSIMA C. Schweinf. in Bot. Mus. Leafl. Harv. Univ. 4:111. 1937.

Small, caespitose, epiphytic herbs up to about 3 cm. tall. Secondary stems very short, up to about 1 mm. long. Leaves 1–2.2 cm. long and 1–2.5 mm. broad, linear-oblanceolate, obtuse or acute, attenuated into a narrow petiole at the base. Inflorescence up to 3 cm. long, exceeding the leaves; scape filiform. Sepals connate into a tube at the base; dorsal sepal about 6 mm. long and 2.5 mm. broad, caudate, the lamina about 2.5 mm. long and as broad, suborbicular. Lateral sepals about 7.5 mm. long and each about 1 mm. broad, caudate, free part of lamina lanceolate. Petals about 2 mm. long and about 0.75 mm. broad, oblong-lanceolate, subtruncate, triapiculate. Lip about 2 mm. long and 0.7 mm. broad, oblong-lanceolate, obtuse, with 2 inconspicuous, submarginal, lamellate calli extending from the base to the middle, shortly bicaudate at the base, the caudae about 0.2 mm. long. Ovary inconspicuously muricate on the angles.

Panama.

COCLÉ: mountains beyond La Pintada, alt. 400–600 m., *Hunter & Allen 587.*

Masdevallia pygmaea Kränzl. will possibly include this species when the type can be studied.

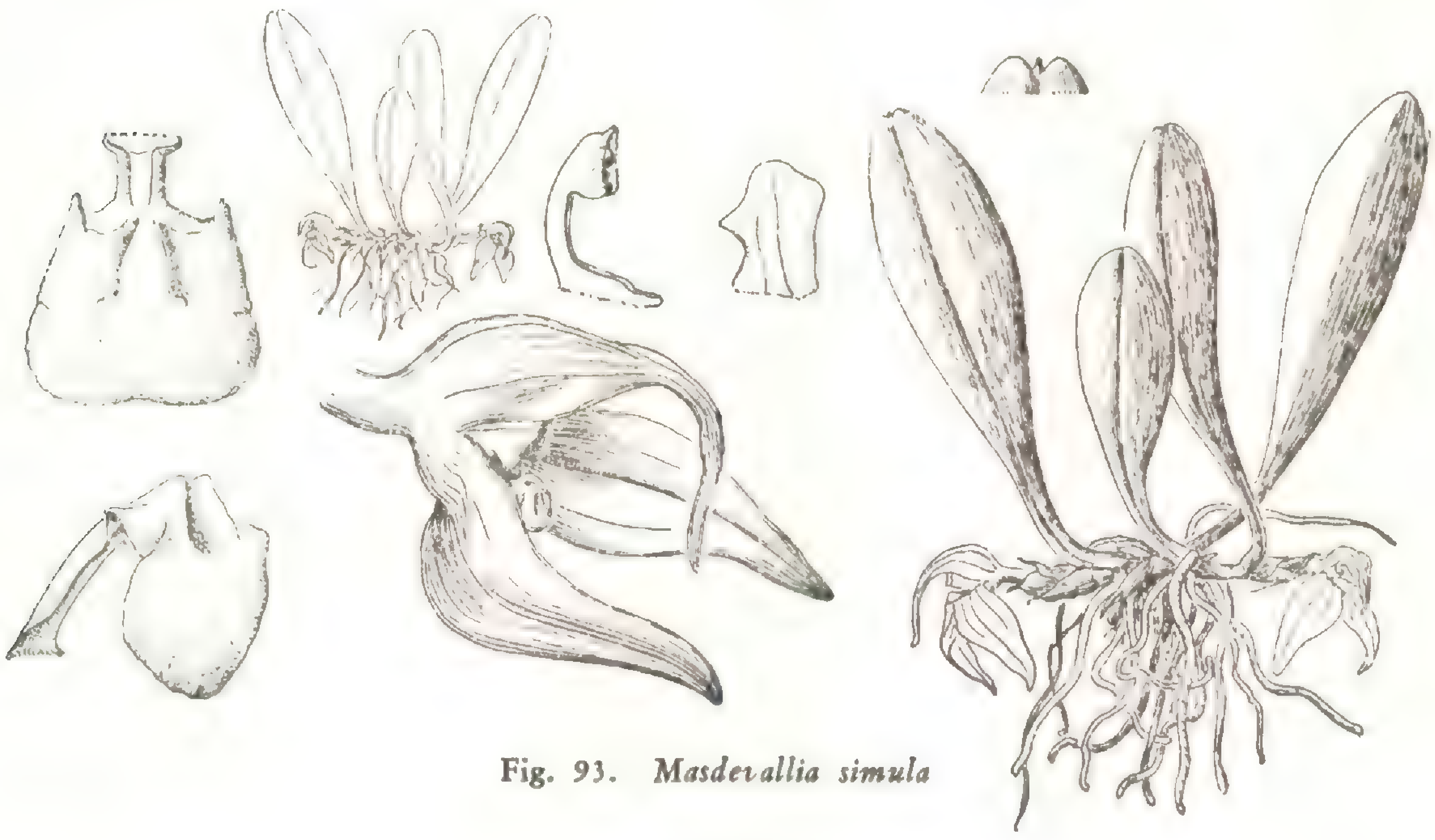


Fig. 93. *Masdevallia simula*

7. Masdevallia simula Reichb. f. in Gard. Chron. n. s. 3:8. 1875; Woolw. Genus Masdevallia, *t.* [*71*]. 1890; L. Wms. in Ann. Missouri Bot. Gard. 27:274, *pl. 31, figs. 1-8.* 1940.

Small caespitose or repent epiphytic herbs up to about 9 cm. tall. Secondary stems up to about 1 mm. long. Leaves 1–10 cm. long and 0.2–0.5 cm. broad, linear to oblanceolate, attenuated into a petiole at the base. Inflorescences 1–3-flowered, much shorter than the leaves. Sepals connate for only a short distance at the base; dorsal sepal 3.5–9 mm. long and 2–4 mm. broad, lanceolate to ovate-lanceolate or triangular-lanceolate, acute, acuminate or caudate; lateral sepals similar to the dorsal except usually somewhat falcate and each provided with a transverse, semi-lunate callus at the base. Petals 1.5–3 mm. long and 1.5–3 mm. broad, subquadrate or subrhombic, angulate. Lip 2–3.5 mm. long and 1.2–3 mm. broad, unguiculate; lamina subquadrate to subquadrate-obovate, biauriculate at the base, with two lamellate calli near the junction with the claw.

Guatemala, Honduras, Costa Rica, Panama, Colombia, and Ecuador.

canal zone: in tops of high trees, Quebrada Lopez, alt. about 30 m., *Allen 2115.*

Masdevallia simula is quite a diverse species in Central America and may prove to be either an aggregate or a polymorphic. It is not a typical *Masdevallia* and might almost as well be placed in *Pleurothallis*. The forms *M. guatemalensis* Schltr. and *M. linearifolia* Ames are included in the description.

8. Masdevallia Allenii L. Wms. in Ann. Missouri Bot. Gard. 27:273, *pl. 31, figs. 12-16.* 1940.

Small caespitose epiphytic herbs up to about 5 cm. tall. Secondary stems about 3 mm. long, covered with white chartaceous sheaths. Leaves 10–20 mm. long and up to 2 mm. broad, linear, acute, coriaceous, subterete and canaliculate. Inflorescence 1-flowered, longer than the leaves; peduncle about 3–4 cm. long. Sepals forming a short tube at the base; lamina of the dorsal sepal 2.5–3 mm. long and 3–3.5 mm. broad, free portion of the lamina triangular, long-caudate, the cauda filiform and about 10 mm. long; lateral sepals 12–15 mm. long, connate to their apices or nearly so, the lamina lanceolate, with a lateral, filiform appendage about 5–6 mm. long near the apex on either

Fig. 94. *Masdevallia Allenii*

side. Petals 1.5–2 mm. long and about 0.75 mm. broad, oblong, obtuse. Lip about 3 mm. long and 1 mm. broad, lanceolate or lanceolate-oblong, obtuse, bicaudate at the base; the lamina with two longitudinal calli.

Panama.

COCLÉ: vicinity of El Valle, alt. 600–1000 m., *Allen 1230.*

20. SCAPHOSEPALUM Pfitzer

SCAPHOSEPALUM Pfitz. in Engler & Prantl, Nat. Pflanzenfam. 2^6:139. 1888; Kränzl. in Fedde Rep. Sp. Nov. Beih. 34:204-219. 1925.

Caespitose or repent epiphytic or terrestrial herbs. Secondary stems very short, unifoliate. Leaves mostly broadest near the apex and attenuated into a petiole at the base. Inflorescence a distichous raceme. Sepals connate at the bases; the dorsal sepal free or nearly so, sometimes caudate; lateral sepals more or less united, usually forming a cymbiform synsepal, often callus-thickened near the apices, the apices often attenuated into tails. Petals much shorter than the sepals. Lip small, articulated to the column-foot. Column erect, produced into a foot at the base; margins of the clinandrium membranaceous and denticulate. Anther terminal, operculate, incumbent; pollinia 2, ceraceous.

Scaphosepalum is hardly distinct from *Masdevallia.* The one Panamanian species might well be placed in *Pleurothallis.*

1. SCAPHOSEPALUM ELASMOTOPUS Schltr. in Fedde Rep. Sp. Nov. 12:204. 1913.
Scaphosepalum longirepens Ames in Proc. Biol. Soc. Wash. 34:153. 1921.

Small, repent, epiphytic herbs. Rhizome elongated. Secondary stems short, up to about 5 mm. long, bearing a leaf or a leaf and a peduncle, with an additional abscission layer in the petiole above the apex of the secondary stem. Leaves 7.5–15 cm. long and 0.7–1.4 cm. broad, oblanceolate, acute, coriaceous, attenuated into a slender petiole at the base. Inflorescence about as long as or shorter than the leaves; raceme distichous, several-flowered, up to about 6 cm. long. Dorsal sepal free nearly to the base, about 5–8 mm. long, obtuse, oblong-ligulate, the apex thickened. Lateral sepals joined nearly to their apices, 6–10 mm. long, the lamina oblong, short-caudate at the apex. Petals 3–3.5 mm. long, elliptic-oblong to elliptic-ovate, oblique, acute. Lip about 3 mm. long, short-unguiculate; lamina oblong-pandurate or ovate-oblong and constricted toward the middle, the terminal lobe rounded, ciliate.

Panama.

CHIRIQUÍ: east of Río Caldera, alt. 2000 m., *Killip 3567;* between Alto de las Palmas and top of Cerro de la Horqueta, alt. 2100–2268 m., *Pittier 3229, 5730.* CANAL ZONE: Quebrada Lopez, alt. 30 m., *Allen 2130.*

This species has been reduced to *Scaphosepalum macrodactylon* Rolfe by Kränzlin. Kränzlin probably did not see material from Panama.

21. LEPANTHES Sw.

LEPANTHES Sw. in Nova Acta Soc. Sci. Upsal. 6:85. 1799; in Svensk. Vet-Akad. Handl. 21:249. 1800.

Small repent or caespitose epiphytic herbs. Stems (secondary stems) generally unifoliate, with several loose, often ciliate and pubescent, sheaths below. Leaves coriaceous. Inflorescence terminal, 1 or few from the base of the leaves, the flowers small, often distichous. Sepals subequal, often more or less connate at the bases or the laterals connate nearly to their apices. Petals shorter than the sepals, bipartite or transversely bilobed, usually short-unguiculate and adnate to the column, except *L. eximia.* Lip bilobed or sometimes trilobed, with the mid-lobe small and inconspicuous, adnate to the column, the lobes usually appearing as wings. Column short, footless, wingless, dilated at the apex; anther terminal, operculate, incumbent; pollinia 2, waxy.

An easily distinguished genus with many closely allied and poorly defined species.

a. Petals simple, not bilobed and transverse .... 8. L. EXIMIA
aa. Petals not simple, bilobed and transverse.
  b. Sepals linear-lanceolate, at least 5 times longer than broad .... 7. L. INSECTIFLORA
  bb. Sepals broader than linear-lanceolate, less than 5 times longer than broad.
    c. Anterior lobe of the petal as long as the dorsal sepal .... 5. L. ROTUNDIFOLIA
    cc. Anterior lobe of the petal shorter than the dorsal sepal.
      d. Dorsal sepal less than 4 mm. long.
        e. Petals 3-nerved .... 6. L. TURIALVAE
        ee. Petals 1-nerved .... 1. L. CHIRIQUENSIS
      dd. Dorsal sepal 4 mm. long or longer.
        f. Petal 1-nerved; dorsal sepal 14–17 mm. long .... 4. L. MAXONII
        ff. Petals 3-(5-)nerved; dorsal sepal 4–8 mm. long.
          g. Dorsal sepal about 4–6 mm. long, ovate .... 3. L. ECILIATA
          gg. Dorsal sepal about 8 mm. long, lanceolate .... 2. L. ELATA

1. LEPANTHES CHIRIQUENSIS Schltr. in Fedde Rep. Sp. Nov. Beih. 17:17. 1922.
Lepanthes micrantha Ames, Sched. Orch. 4:31. 1923.

Small, caespitose, epiphytic herbs up to 10 cm. tall. Secondary stems slender, up to about 8 mm. long. Leaves 1–4 cm. long and 0.3–1.1 cm. broad, variable, linear-lanceolate to ovate. Inflorescence few-flowered, shorter than the leaves. Dorsal sepal 2–2.5 mm. long and 1.2–1.5 mm. broad, oblong-ovate to lanceolate-ovate, acute. Lateral sepals 1.5–2 mm. long and 0.75–1.2 mm. broad, ovate-lanceolate, acute, arcuate, sometimes denticulate toward the apex. Petals 0.5–0.7 mm. long and 2–2.5 mm. broad, transverse, ciliate, the lobes lanceolate to ovate-lanceolate. Lip 0.75–1.2 mm. long and 0.75–1 mm. broad, 3-lobed; the lateral lobes malleoliform, about 0.75–1.2 mm. long; mid-lobe small, apiculiform, about 0.2 mm. long.

Costa Rica and Panama.

CHIRIQUÍ: vicinity of Monte Lirio, valley of upper Río Chiriquí Viejo, alt. 1300–1900 m., *Seibert 174, 194, 198;* "Province of Chiriquí," alt. 4500 ft., *Powell 254.*

Lepanthes chiriquensis has been referred to *L. Lindleyana* Oerst. & Reichb. f. as a synonym, which it may be, but the original description and figures of *L. Lindleyana* are either very inaccurate or the species is quite different.

2. Lepanthes elata Reichb. f. Beitr. Orch. Centr.-Am. 90. 1866.

Rather large, caespitose, epiphytic herbs up to 6 dm. tall. Secondary stems up to 5 dm. long, covered with scarious sheaths which are glabrous or at most ciliate. Leaves 3.5–12 cm. long and 1.8–7 cm. broad, lanceolate-ovate to oval, acuminate. Inflorescences 1 or more from the axils of each leaf, densely flowered; bracts very crowded, ovate-acuminate, infundibuliform. Dorsal sepal about 8 mm. long and 3 mm. broad, lanceolate, acuminate. Lateral sepals about 8 mm. long and 3 mm. broad, lanceolate, acuminate, somewhat oblique, connate nearly to the middle. Petals transverse, about 5 mm. broad; the posterior lobe about 2.5 mm. long, oblong-obovate; the anterior lobe about 2.5 mm. long and about 2 mm. broad, the lateral lobes malleoliform, the mid-lobe small, apiculiform.

Costa Rica and Panama.

chiriquí: Bajo Chorro, alt. 6000 ft., *Davidson 237*.

3. Lepanthes eciliata Schltr. in Fedde Rep. Sp. Nov. 12:203. 1913.

Erect, caespitose, epiphytic herbs up to about 18 cm. tall. Secondary stems slender, covered with several sheaths, the mouths of which are eciliate but puberulous. Leaves 3.5–7.5 cm. long and 0.8–1.8 cm. broad, elliptic or lanceolate, erect, attenuated to the base. Inflorescences several, about half as long as the leaves. Sepals ovate, ciliate; dorsal sepals about 4–6 mm. long and about 3.5 mm. broad, short-acuminate; lateral sepals about 4–5 mm. long and together about 3.5 mm. broad, acuminate, oblique, connate to about the middle. Petals about 4 mm. broad, transverse, glabrous; anterior lobe oblong, oblique, obtuse; posterior lobe narrowly oblong, obtuse, oblique. Lip about 1–1.5 mm. long, bipartite and with an apicule in the sinus, lobes semirhombic, obtuse, glabrous.

Panama.

chiriquí: Bajo Chorro, alt. about 1800 m., *Davidson 128 in part;* Cerro de la Horqueta, alt. 1700 m., *Pittier 3173*.

4. Lepanthes Maxonii Schltr. in Fedde Rep. Sp. Nov. 12:204. 1913.

Small, caespitose, epiphytic herbs up to about 15 cm. tall. Secondary stems up to about 9 cm. long, covered with several pubescent or scabrous infundibuliform bracts. Leaves 3.5–5.5 cm. long and 1.5–2.5 cm. broad, ovate, acuminate, apex tridenticulate. Inflorescence distichous, fractiflex, exceeding the leaves; flowers large for the genus. Sepals connate at the base; dorsal sepal 14–17 mm. long and about 4–5 mm. broad, triangular-lanceolate or lanceolate, long-acuminate; lateral sepals connate to the middle or beyond, 12–17 mm. long and together 5–6 mm. broad, broadly lanceolate, acute or acuminate. Petals transverse, about 3–4 mm. broad; anterior lobe narrowly oblong to lanceolate, arcuate, acute or obtuse, about equal to the posterior lobe in length; posterior lobe narrowly lanceolate,

arcuate, acute. Lip about 1 mm. long and 1 mm. broad, bipartite, the lobes subrhombic.

Panama.

CHIRIQUÍ: between Alto de las Palmas and Cerro do la Horqueta, alt. 2100–2268 m., *Maxon 3256;* same locality, *Pittier 5494.*

5. LEPANTHES ROTUNDIFOLIA L.Wms. in Ann. Missouri Bot. Gard. 27: 275, *pl. 31, figs. 9-11.* 1940.

Small, caespitose, epiphytic herbs up to about 8 cm. tall. Secondary stems slender, covered with sheaths which are glabrous except at their margins. Leaves about 25 mm. long and 19–28 mm. broad, orbicular or orbicular-ovate, or even broader than long, coriaceous. Inflorescence distichous, shorter than the leaves. Dorsal sepal about 3 mm. long and 2 mm. broad, suborbicular, abruptly acuminate. Lateral sepals about 2.5 mm. long and 2 mm. broad, suborbicular, obtuse or acutish, connate at their bases. Petals bipartite; lobes near the dorsal sepal longest, about 3.5 mm. long and 1 mm. broad, lanceolate, acute, oblique; lobes near the lateral sepals about 2 mm. long and 0.8 mm. broad, lanceolate, acute, oblique. Lip bipartite, about 1.5 mm. long and 2 mm. broad, the lobes malleoliform.

Panama.

COCLÉ: north rim, vicinity of El Valle, alt. 800–1000 m., *Allen 1835.*

Fig. 95. *Lepanthes rotundifolia*

6. LEPANTHES TURIALVAE Reichb. f. in Bonplandia 3:225. 1855; Xenia Orch. 1:151, *t. 50, figs. V, 15-16.* 1855.

Small epiphytic herbs up to 15 cm. tall. Secondary stems slender, covered with sheaths which are usually dark-colored. Leaves 1.5–4.5 cm. long and 0.9–2 cm. broad, elliptic-oblong to suborbicular, attenuated into a short petiole at the base. Sepals lanceolate to ovate-lanceolate, acute; dorsal sepal about 2.5–3.5 mm. long and 1.5–2.2 mm. broad; lateral sepals about 2.2–3 mm. long and 1–1.5 mm. broad, connate to the middle or beyond. Petals about 0.5–1.5 mm. long and 3–4 mm. broad, transverse, posterior lobe the larger. Lip about 1–1.5 mm. long and 1.5–2 mm. broad, trilobate; the lateral lobes large and peltate or flattened; midlobe apiculiform.

Mexico to Panama.

CHIRIQUÍ: vicinity of Casita Alta, alt. 1500–2000 m., *Woodson, Allen & Seibert 954.* COCLÉ: vicinity of El Valle, alt. 600–1000 m., *Allen 1241;* north of El Valle de Antón, alt. 800–1000 m., *Allen 2265.*

The description is based on Panamanian material only. *Lepanthes turialvae,* as now delimited, is possibly an aggregate of several species.

7. LEPANTHES INSECTIFLORA C. Schweinf. in Bot. Mus. Leafl. Harv. Univ. 7:152. 1939.

Small, caespitose, epiphytic herbs up to about 9 cm. tall. Secondary stems slender, 2.5–7.5 cm. long. Leaves up to 2.5 cm. long and 0.9 mm. broad, elliptic-oval to subrhombic, apex tridenticulate. Inflorescence several-flowered, shorter than the leaves. Sepals about 5 mm. long and 0.5–1 mm. broad, linear-lanceolate, acuminate. Petals transversely bipartite; posterior lobe about 3 mm. long, subfiliform; anterior lobe about 0.7 mm. long, subovate. Lip about 1 mm. long and as broad, suborbicular, deeply emarginate and bilobed, with a minute apicula in the sinus.

Panama.

CHIRIQUÍ: Bajo Chorro, alt. about 1800 m., *Davidson 185.*

Differs from *L. tipulifera* Reichb. f. only in having the anterior lobe of the petal shorter. Material seen inadequate.

8. LEPANTHES EXIMIA Ames, Sched. Orch. 5:21. 1923.

Lepanthes abnormis Schltr. in Fedde Rep. Sp. Nov. Beih. 19:21. 1923.

Small, caespitose, epiphytic herbs up to 6 cm. tall. Secondary stems very slender, up to 4 cm. long, covered with infundibuliform sheaths. Leaves 0.6–2 cm. long, 0.4–0.7 cm. broad, elliptic to oval, acute or obtuse, attenuated to the base. Sepals 2–3 mm. long and 1–1.5 mm. broad, ovate-lanceolate, acute or acuminate, denticulate. Petals 1–1.5 mm. long and 0.2–0.4 mm. broad, linear, auriculate on the anterior margin at the base, not transverse. Lip 1–1.4 mm. long and 0.6–0.8 mm. broad, oblong to subquadrate, short-unguiculate, retuse or emarginate, ecallose.

Costa Rica and Panama.

CHIRIQUÍ: Bajo Chorro, alt. about 1800 m., *Davidson 186.*

Unusual in having petals which are not transverse.

22. ACOSTAEA Schltr.

ACOSTAEA Schltr. in Fedde Rep. Sp. Nov. Beih. 19:283. 1923.

Small, caespitose, epiphytic herbs. Secondary stems very short, unifoliate, covered with a loose sheath. Leaves subcoriaceous, attenuated into a petiole at the base and with an abscission layer above the one at the apex of the secondary stem. Inflorescence terminal, usually one from each stem, few-flowered; flowers small. Dorsal sepal broad, cucullate, enclosing the column. Lateral sepals connate into an oblong, bidentate lamina, longer than the dorsal sepal. Petals small,

linear, inserted on the apex of the column-foot, retuse at the apex and with a large, auriculate, hood-shaped callus or ligule toward the base. Column arcuate, with a broad, membranaceous wing on each side; column-foot elongated, subequal to the column; pollinia 2, ceraceous.

A small genus of only two species, one Panamanian. Perhaps the most distinctive of the Pleurothalloid genera in Central America.

1. ACOSTAEA COSTARICENSIS Schltr. in Fedde Rep. Sp. Nov. Beih. 19:284. 1923.

Very small, caespitose, epiphytic herbs up to about 3 cm. tall. Secondary stems up to about 1 mm. long. Leaves 9–15 mm. long and 2.5–6 mm. broad, obovate-spatulate, obtuse, attenuated into a petiole at the base. Inflorescence up to about 3 cm. long, few-flowered; peduncle slender, exceeding the leaves; flowers small. Dorsal sepal 2.5–3 mm. long and 3–4 mm. broad, suborbicular, transverse, strongly cucullate, obtuse. Lateral sepals 4–5.5 mm. long and together 2–2.5 mm. broad, elliptic to elliptic-oblong, connate nearly to their apices and with the free parts acute. Petals 1.5–2 mm. long and 0.3–0.5 mm. broad, ligulate, obtuse or acute, falcate. Lip 2–2.5 mm. long and 0.5–1 mm. broad, with a large, thin, hood-shaped callus near the base, apex emarginate and the lobules divergent. Column arcuate, broadly winged, the wings membranaceous and subquadrate.

Costa Rica and Panama.

COCLÉ: hills north of El Valle de Antón, alt. about 1000 m., *Allen 2352;* trail to Las Minas, El Valle de Antón, alt. 1000 m., *Allen 2892;* mountains beyond La Pintada, alt. 400–600 m., *Hunter & Allen 593.*

23. PLEUROTHALLIS R. Br.

PLEUROTHALLIS R. Br. in Aiton, Hort. Kew. ed. 2, 5:211. 1813; Lindl. Folia Orch. Pleuroth. 1859.

Restrepia HBK. Nov. Gen. & Sp. Pl. 1:366, *t. 94.* 1816.
Kraenzlinella O. Ktze. in Post & Kuntze, Gen. Phan. 310. 1904.
Platystele Schltr. in Fedde Rep. Sp. Nov. 8:565. 1910.

Small to medium-sized epiphytic herbs with caespitose or repent primary stems. Inflorescence terminal or rarely pseudo-radical. Sepals subequal, erect or spreading; dorsal sepal free or connate with the lateral sepals for a short distance, apex sometimes clavellate; lateral sepals from nearly free to connate to their tips, often gibbous at the base. Petals usually shorter and narrower than the sepals, apices plain or clavellate. Lip simple or three-lobed, shorter or about as long as, or sometimes longer than, the petals, often unguiculate. Column about as long or shorter than the lip, winged or wingless, produced into a foot, or sometimes footless at the base; column-foot, when present, from short to as long as the column. Anther terminal, operculate; pollinia 2 or 4, ceraceous.

Pleurothallis is one of the largest of the New World genera of orchids with many diverse forms. The division of the genus most often used is that which was proposed by Pfitzer (in Engl. & Prantl, Nat. Pflanzenfam., Nachträge zu Teil II-IV:105. 1897), but that is wholly artificial and quite impossible to use. The

separations used here are quite as artificial as those of Pfitzer and have nothing to recommend them except, as far as the Panamanian species are concerned, they are convenient even though they are not absolute. Further, it may cause allied species to be widely separated.

a. Apices of the dorsal sepals or of the petals not clavellate.
  b. Sheaths not appressed to the stems, ciliate at their mouths....Series I. LEPANTHIFORMES (p. 86)
  bb. Sheaths usually appressed to the stems, their mouths always glabrous.
    c. Inflorescence exceeded by the subtending leaf, 1-flowered, fascicled or racemose ....Series II. BRACHYSTACHEAE (p. 86)
    cc. Inflorescence subequal to or exceeding the subtending leaf, 1-flowered, a fascicle on a long peduncle, or racemose......Series III. ELONGATAE (p. 87)
aa. Apices of the dorsal sepals and of the petals clavellate..........Series IV. RESTREPIAE (p. 88)

Series I. LEPANTHIFORMES.—A small, rather natural group of species which are easily distinguished by the loose ciliate sheaths; inflorescence either longer or shorter than the subtending leaf.
a. Petals not ciliate nor ciliate-lacerate toward the apex; stems with 1–3 leaves.......... 1. P. BROADWAYI
aa. Petals ciliate or ciliate-lacerate toward the apex.
  b. Sepals glandular-pubescent dorsally.......... 2. P. GNOMONIFERA
  bb. Sepals glabrous and smooth dorsally.
    c. Leaves narrowly elliptic to oval, margins not recurved.......... 3. P. BLAISDELLII
    cc. Leaves broadly oval to suborbicular-ovate, sphacelate margins prominently recurved.......... 4. P. ROTUNDATA

Series II. BRACHYSTACHEAE.—An artificial group which probably has no phylogenetic value but is of value in separating and keying species of this difficult genus. Plants in which the inflorescence is exceeded by the subtending leaf. Inflorescence a single flower, a fascicle of flowers, a raceme or fascicle of racemes.
a. Inflorescence a fascicle of one to many flowers at the apex of the secondary stem.
  b. Leaves distinctly cordate at the base, mostly broad.
    c. Lip about 6 mm. long; petals 2- to 3-nerved; flowers relatively large.......... 5. P. CARDIOCHILA
    cc. Lip 4 mm. or less long; petals 1-nerved; flowers relatively small.
      d. Petals ciliate or denticulate.
        e. Base of the lamina of the lip with a transverse E-shaped callus.......... 6. P. RHODOGLOSSA
        ee. Base of the lamina of the lip without an E-shaped callus.
          f. Lip triangular or triangular-subquadrate; disc smooth.......... 7. P. TRIANGULABIA
          ff. Lip cordate to oblong-cordate; disc verrucose.......... 8. P. ANTONENSIS
      dd. Petals neither ciliate nor denticulate.
        e. Base of the lip with linear-lanceolate arms; petals semi-terete above.......... 9. P. ARIETINA
        ee. Base of the lip without lateral arms; petals not semi-terete.
          f. Base of lamina of the lip with a transverse E-shaped callus.......... 6. P. RHODOGLOSSA
          ff. Base of the lamina of the lip without a transverse E-shaped callus.......... 10. P. HOMOLANTHA
  bb. Leaves not distinctly cordate at the base, usually attenuated.
    c. Secondary stems winged.......... 25. P. ALPINA
    cc. Secondary stems not winged.
      d. Lateral sepals free at least above the middle, usually nearly to their bases.
        e. Ovary echinate.......... 20. P. TRIBULOIDES
        ee. Ovary not echinate.
          f. Petals abruptly dilated at the base.......... 15. P. TRACHYCHLAMYS
          ff. Petals not abruptly dilated at the base.
            g. Lip simple.......... 18. P. OCTOMERIAE
            gg. Lip with small falcate lateral lobes above the base.......... 19. P. UNCINATA
      dd. Lateral sepals connate to their apices or nearly so.

e. Lip deeply saccate-concave .... 12. P. CONCAVIFLORA
ee. Lip not saccate-concave.
f. Petals serrulate (or ciliate).
g. Dorsal sepal suborbicular; lip not *Stelis*-like .... 13. P. COBRAEFORMIS
gg. Dorsal sepal lanceolate; lip *Stelis*-like .... 11. P. SIMULANS
ff. Petals entire (sometimes ciliolate).
g. Sepals forming a distinct tube at the base, hispidulous dorsally .... 21. P. HISPIDA
gg. Sepals not forming a distinct tube at the base, the dorsal free from the laterals, glabrous.
h. Ovaries echinate .... 20. P. TRIBULOIDES
hh. Ovaries not echinate.
i. Lip about as broad as long, with large basal lobes .... 14. P. ALLENII
ii. Lip longer than broad, simple or at least not with large basal lobes.
j. Pedicels of the flowers less than 1/4 as long as the leaves .... 17. P. RUSCIFOLIA
jj. Pedicels of the flowers at least half as long as the leaves .... 16. P. EUMECOCAULON
aa. Inflorescence a few- to several-flowered raceme.
b. Secondary stems less than half as long as the leaves they bear.
c. Sepals pubescent within .... 46. P. SEGOVIENSIS
cc. Sepals glabrous within.
d. Inflorescence a fascicle of short racemes, much shorter than the subtending leaf .... 36. P. STENOSTACHYA
dd. Inflorescence a single raceme nearly as long as the subtending leaf .... 37. P. OVATILABIA
bb. Secondary stems at least half as long as the leaves that they bear.
c. Petals linear or linear-lanceolate, entire.
d. Lip lepidote-verrucose above .... 28. P. LEPIDOTA
dd. Lip not lepidote-verrucose above .... 42. P. PRUINOSA
cc. Petals broader than linear or linear-lanceolate (or if not then serrulate), entire or serrulate.
d. Petals very strongly recurved-arcuate; denticulate .... 33. P. ROWLEEI
dd. Petals not strongly recurved-arcuate; denticulate or entire.
e. Lip broader than long, transversely elliptic .... 34. P. PRAEGRANDIS
ee. Lip not broader than long nor transversely elliptic.
f. Lip with small lateral lobes near the middle.
g. Secondary stems with prominent wings. (Cf. also P. VELATICAULIS)
h. Dorsal sepal 9–11 mm. long, elliptic-obovate .... 29. P. COGNIAUXIANA
hh. Dorsal sepal 6–6.5 mm. long, elliptic to oblong-oblanceolate .... 25. P. ALPINA
gg. Secondary stems wingless.
h. Petals denticulate, obovate .... 30. P. VITTATA
hh. Petals not denticulate, oblong to oblong-oblanceolate .... 31. P. VELATICAULIS
ff. Lip without lateral lobes near the middle.
g. Petals not serrulate.
h. Lip with erect auricles near the middle; petals oblong to oblong-oblanceolate .... 31. P. VELATICAULIS
hh. Lip without erect auricles near the middle; petals oblong-obovate to subrhombic .... 32. P. GELIDA
gg. Petals serrulate at least in part.
h. Lateral sepals connate to their apices; petals elliptic to elliptic-lanceolate .... 35. P. ELLIPSOPHYLLA
hh. Lateral sepals free for at least 1/3 their length; petals broader than elliptic or elliptic-lanceolate.
i. Petals oblong-oblanceolate .... 27. P. VERECUNDA
ii. Petals subrhombic-obovate .... 26. P. PTEROCAULIS

Series III. ELONGATAE.—A series of species not necessarily closely allied but having the elongated inflorescence in common. Plants in which the inflorescence exceeds the subtending leaves in length. Inflorescence a single-flowered to a many-flowered raceme or a fascicle of flowers on an elongated peduncle.

a. Inflorescence a 1- to several-flowered fascicle on a long peduncle.

b. Lateral lobes of the lip erect; lamina with a pair of parallel lamellate calluses near the middle........ 23. P. FULGENS
bb. Lateral lobes of the lip, if present, not erect; lamina without parallel lamellate calluses.
c. Peduncle puberulent........ 24. P. GLANDULOSA
cc. Peduncle glabrous........ 22. P. BRIGHAMII
aa. Inflorescence a raceme.
b. Peduncle ancipitous and winged.
c. Apex of the lip obtuse or retuse........ 50. P. SPECTABILIS
cc. Apex of the lip acute........ 49. P. PFAVII
bb. Peduncle not ancipitous nor winged.
c. Lateral sepals free nearly to their bases, at least not connate to near the middle.
d. Ovary muricate........ 51. P. MURICATA
dd. Ovary not muricate.
e. Disc of the lip with 3 prominent longitudinal calluses........ 48. P. DOLICHOPUS
ee. Disc of the lip without prominent longitudinal calluses.
f. Sepals 10 mm. or more long........ 52. P. CRENATA
ff. Sepals 19 mm. or less long.
g. Petals fimbriate or lacerate-fimbriate........ 41. P. ARISTATA
gg. Petals not as above.
h. Lip narrowly oblong; lateral sepals acuminate........ 39. P. CALYPTROSTELE
hh. Lip ovate; lateral sepals acute or obtuse........ 37. P. OVATILABIA
cc. Lateral sepals connate to about the middle or usually to near their apices.
d. Secondary stems less than half as long as the leaves they bear.
e. Ovary echinate........ 40. P. FUEGII var. ECHINATA
ee. Ovary not echinate.
f. Petals fimbriate or lacerate-fimbriate........ 41. P. ARISTATA
ff. Petals not fimbriate nor lacerate-fimbriate.
g. Lip 3-lobed; sepals pubescent within........ 46. P. SEGOVIENSIS
gg. Lip simple; sepals glabrous within........ 38. P. GROBYI
dd. Secondary stems at least half as long as the leaves they bear.
e. Petals linear or linear-lanceolate........ 42. P. PRUINOSA
ee. Petals not linear nor linear-lanceolate, either lanceolate or oblong or broader.
f. Petals truncate........ 43. P. MACRANTHA
ff. Petals acute to obtuse or rounded but not truncate.
g. Sepals pubescent within........ 46. P. SEGOVIENSIS
gg. Sepals glabrous within.
h. Lateral sepals 5–9 mm. long.
i. Petals elliptic-lanceolate to ovate-lanceolate, 6–8.5 mm. long........ 47. P. GHIESBREGHTIANA
ii. Petals oblong-obovate to subrhombic, 2.5–3.5 mm. long........ 32. P. GELIDA
hh. Lateral sepals 12–25 mm. long.
i. Lip with erect basal auricles or lobes; petals verrucose at the apex........ 44. P. TUERCKHEIMII
ii. Lip without basal auricles or lobes; petals not verrucose at the apex........ 45. P. POWELLII

Series IV. RESTREPIAE.—A small, natural group of species mainly distinguished by the clavellate apices of the dorsal sepal and the petals. Sheaths of the secondary stems usually maculate.
a. Disc of the terminal part of the lip verrucose; inflorescence more than half as long as the leaves.
b. Pedicel with a short filamentose appendage on the anterior side just below the ovary........ 53. P. FILAMENTOSA
bb. Pedicel without an appendage........ 54. P. SUBSERRATA
aa. Disc of the terminal part of the lip not verrucose; inflorescence less than half as long as the leaf........ 55. P. XANTHOPHTHALMA

1. PLEUROTHALLIS BROADWAYI Ames, Orch. 2:267. 1908; C. Schweinf. in Bot. Mus. Leaf. Harv. Univ. 8:41. 1940.

Pleurothallis Williamsii Ames, Orch. 7:120. 1922; Sched. Orch. 7:31, *t. 15*. 1924.
Pleurothallis Broadwayi var. *tricarinata* C. Schweinf. loc. cit. 42.

Small, caespitose, epiphytic herbs up to about 15 cm. tall. Secondary stems up to about 6 cm. long, slender, bearing 1–3 leaves. Inflorescence exceeding the leaves; peduncle subfiliform, rachis somewhat fractiflex. Leaves 0.6–1.6 cm. long and 0.3–0.8 cm. broad, elliptic-oval to obovate, obtuse, short-petiolate. Dorsal sepal 3.5–6 mm. long and 1.2–2 mm. broad, lanceolate to ovate-lanceolate, acute or acuminate, somewhat cucullate. Lateral sepals 3–5.5 mm. long and 0.6–1.2 mm. broad, free almost to the base, lanceolate, acute or acuminate, oblique. Petals 1.1–1.5 mm. long and 0.6–0.8 mm. broad, oval to obovate, obtuse, slightly oblique, short-clawed. Lip 1–2 mm. long and 0.7–1.1 mm. broad, elliptic-ovate, obtuse, sometimes obscurely trilobate, the lamina bi-tricarinate, papilliferous, the apex thickened.

Fig. 96. *Pleurothallis Broadwayi*

Mexico, Honduras, Costa Rica, Panama, and the West Indies.

DARIÉN: Cana and vicinity, alt. about 600–1950 m., *Williams 976.*

2. PLEUROTHALLIS GNOMONIFERA Ames, Sched. Orch. 6:61. 1923.
Pleurothallis brevis Schltr. in Fedde Rep. Sp. Nov. Beih. 19:183. 1923.

Small, caespitose, epiphytic herbs up to 12 cm. tall. Secondary stems up to about 8 cm. long, covered with infundibuliform, hispidulous sheaths. Leaves 1.4–4.5 cm. long and 0.6–2 cm. broad, elliptic to ovate, acute or obtuse, coriaceous, attenuated into a short petiole at the base. Inflorescence one to several racemes from the axil of the leaf, usually less than half as long as the leaves, few-flowered. Sepals glandular-pubescent dorsally; dorsal sepal about 3–4 mm. long and 1 mm. broad, oblong-lanceolate, acute or obtuse; lateral sepals 3–4 mm. long and together 2.5–3 mm. broad, connate at the base or as far as the middle, free parts oblong, obtuse. Petals about 1.5 mm. long and 0.5 mm. broad, oblong, obtuse, ciliate or lacerate at the apex. Lip 1.6–2 mm. long and 0.5–0.6 mm. broad, narrowly oblong, obtuse, subpandurate, biauriculate at the base, with a small submammillate callus near the base of the disc.

Costa Rica and Panama.

CHIRIQUÍ: Cerro Punta to headwaters of the Río Caldera, alt. 2250–2500 m., *Allen 1466;* Cerro Horqueta, alt. 1500–1800 m., *Powell 311.*

Fig. 97. *Pleurothallis Blaisdellii*

3. Pleurothallis Blaisdellii S. Wats. in Proc. Am. Acad. 23:284. 1888.

Pleurothallis peraltensis Ames, Sched. Orch. 6:65. 1923; loc. cit. 7: *t. 11, figs. 1-5.* 1924.

Small, caespitose, epiphytic herbs up to about 15 cm. tall. Secondary stems up to 10 cm. long, covered with several more or less pubescent, loose sheaths which disintegrate with age. Leaves 2–6.5 cm. long and 0.4–2 cm. broad, narrowly elliptic to oval, acute or obtuse, coriaceous, attenuated into a short petiole at the base. Inflorescence a raceme or fascicle of racemes, short, usually less than half as long as the leaves, few-flowered. Dorsal sepal 4–6 mm. long and 1.5–2 mm. broad, lanceolate to oblong-lanceolate, acute, usually eciliate. Lateral sepals 4–6 mm. long and together 2.5–3 mm. broad, connate at the bases or nearly to the middle, free portions oblong-lanceolate, acute or obtuse, usually ciliate toward the base on the outer side. Petals 2–2.5 mm. long and 1–1.5 mm. broad, oblong, obtuse, apical part ciliate or fimbriate. Lip 2.5–3 mm. long and 0.75–1 mm. broad, oblong-lanceolate or oblong-pandurate, obtuse, ciliate, auriculate at the base, short-unguiculate.

Mexico, British Honduras, Honduras, Costa Rica, and Panama.

chiriquí: Bajo Chorro, alt. about 1800 m., *Davidson 169;* "Chiriquí Province," alt. about 1200 m., *Powell 424.*

4. Pleurothallis rotundata C. Schweinf. in Bot. Mus. Leafl. Harv. Univ. 4:115. 1937.

Small, caespitose, epiphytic herbs up to about 13 cm. tall. Secondary stems up to about 9 cm. long, slender, covered with several hispid, infundibuliform sheaths. Leaves 2.5–4.5 cm. long and 2–3.7 cm. broad, broadly oval to sub-orbicular-ovate, obtuse, with a very short petiole, the margins sphacelate and rolled toward the dorsal surface. Inflorescence a fascicle of 1(–few?)-flowered racemes, shorter than the leaves. Dorsal sepal 4.5–5.5 mm. long and 1.5–2.1 mm. broad, lanceolate, acute or acuminate, ciliate or eciliate. Lateral sepals about 5 mm. long and together 2.5–3 mm. broad, ovate-lanceolate, connate to about the middle, free apices fleshy-thickened, ciliate laterally toward the base and near the sinus within. Petals about 1.5 mm. long and 0.75 mm. broad, oblong or oblong-obovate, obtuse, the apex ciliate-lacerate. Lip 2.5–3 mm. long and 0.8–1 mm. broad, lanceolate to ligulate-lanceolate, acute or acuminate, ciliolate, short-unguiculate.

Endemic to Panama.

COCLÉ: vicinity of El Valle, alt. 600–1000 m., *Allen 1242;* north rim of El Valle de Antón, alt. 600–1000 m., *Allen 1676;* hills north of El Valle de Antón, alt. about 1000 m., *Allen 2206, 2259;* mountains beyond La Pintada, alt. 400–600 m., *Hunter & Allen 561.*

Fig. 98. *Pleurothallis cardiochila*

5. PLEUROTHALLIS CARDIOCHILA L. Wms. in Ann. Missouri Bot. Gard. 29:343. 1942.

Small, caespitose, epiphytic herbs up to about 21 cm. tall. Secondary stems up to about 11 cm. long, slender, with 1–2 loose chartaceous sheaths toward the base, naked above. Leaves 9–10 cm. long and 3.6–3.9 cm. broad, lanceolate-cordate, acuminate, coriaceous. Inflorescence a 1(–few?)-flowered fascicle subtended by a chartaceous sheath about 1–1.5 cm. long, much shorter than the leaves. Flowers very large for the group, yellowish with the dorsal sepal tinged with dark red, lip

deep orange. Dorsal sepal about 20 mm. long and 12.5 mm. broad, oblong-oval, obtuse, with 7–9 principal nerves, strongly cucullate. Lateral sepals connate to their apices, about 18 mm. long and 10 mm. broad, ovate, acute, with 7–9 principal nerves. Petals about 13 mm. long and 2.5 mm. broad, linear-oblong, acute, arcuate, subauriculate on the posterior margin at the base, entire, 3-nerved at the base, the posterior nerve short, the anterior nerve branched near the base, hence the apical part of the petal 3-nerved. Lip unguiculate; lamina about 6 mm. long and 5.5 mm. broad, suborbicular-cordate, obtuse, callus thickened along the basal sinus and below the subapiculate apex, 3-nerved; claw about 2 mm. long, oblong.

Endemic in Panama.

CHIRIQUÍ: Bajo Chorro, alt. about 1800 m., *Davidson 119*.

Pleurothallis cardiochila is most closely allied to *P. palliolata* Ames, from which it is distinguished by the suborbicular-cordate lip and the 3-nerved, entire petals.

6. PLEUROTHALLIS RHODOGLOSSA Schltr. in Fedde Rep. Sp. Nov. Beih. 17:22. 1922.

Small, caespitose, epiphytic herbs up to about 2 dm. tall. Secondary stems up to about 13 cm. long, slender, with 1–2 sheaths at the base, otherwise naked. Leaves 4–7 cm. long and 2.2–4 cm. broad, broadly ovate-cordate, acute or acuminate, coriaceous. Flowers rather small, greenish with a purple lip. Dorsal sepal about 3.5–4 mm. long and 1.8–2.2 mm. broad, oblong-obovate, obtuse, 3-nerved. Lateral sepals about 3 mm. long and 3 mm. broad, orbicular, connate to the apices. Petals about 2–2.5 mm. long and 0.5–0.7 mm. broad, linear-ligulate, acute, slightly arcuate, obscurely denticulate (ciliolate, fide Schltr.). Lip about 1.4–1.7 mm. long and 1.1–1.3 mm. broad, cordate or narrowly cordate, obtuse; lamina fleshy and with a transverse E-shaped callus toward the base (open part of the "E" toward the base).

Panama.

CHIRIQUÍ: "Province of Chiriquí," alt. 1200 m., *Powell 182*. (Schlechter in his description cites *Powell 182* but gives the locality as "Auf Hügeln bei Panama-city").

Two specimens of this have been seen. The one in the Ames Herbarium gives the data cited above. The specimen in the Herbarium of the Missouri Botanical Garden bears the data given by Schlechter. The Chiriquí locality is doubtless correct.

7. PLEUROTHALLIS TRIANGULABIA C. Schweinf. in Ann. Missouri Bot. Gard. 24:183. 1937.

Caespitose epiphytic herbs up to about 4 dm. tall. Secondary stems up to about 3 dm. long, slender, with loose sheaths which soon disintegrate. Leaves 3.5–12 cm. long and 1.3–6 cm. broad, oblong-cordate to ovate-cordate, acuminate, coriaceous. Inflorescence a 1- to few-flowered fascicle, the flowers rather large. Dorsal sepal 9–12 mm. long and 6–9 mm. broad, oblong-ovate to oval, acute or obtuse, larger than the combined laterals. Lateral sepals 9–12.5 mm. long and

together 5–8 mm. broad, ovate-lanceolate to broadly ovate, acute or obtuse, connate to their tips. Petals 6–8 mm. long and 1.5–2.1 mm. broad, elliptic-linear, acute, ciliate to lacerate-dentate, arcuate. Lip 3.2–4 mm. long and 3–4 mm. broad, triangular to triangular-subquadrate, surface verrucose, base truncate with a submammillate callus in the middle with cavities on either side.

Costa Rica and Panama.

CHIRIQUÍ: Cerro Punta to headwaters of the Río Caldera, alt. 2250–2500 m., *Allen 1468;* valley of the upper Río Chiriquí Viejo, alt. 1300–1900 m., *Seibert 269;* Bajo Chorro, alt. 1800 m., *Davidson 223.*

8. PLEUROTHALLIS ANTONENSIS L. Wms. in Ann. Missouri Bot. Gard. 29:341. 1942.

Caespitose epiphytic herbs up to about 3 dm. tall. Secondary stems slender, with one or two scarious sheaths at the base, naked above. Leaves 4–9 cm. long and 1.5–4.7 cm. broad, lanceolate-cordate to broadly cordate (juvenile leaves elliptic), acute or acuminate, coriaceous. Inflorescence a 1- to several-flowered fascicle from the apex of the secondary stems, much shorter than the subtending leaves. Dorsal sepal 6–7.5 mm. long and 3–4 mm. broad, elliptic-obovate, obtuse or acute, 3-nerved. Lateral sepals connate to their apices, 5.5–7 mm. long and 4–5 mm. broad, ovate to broadly ovate, obtuse or acute, 6-nerved. Petals 3.8–4.5 mm. long and 0.6–1 mm. broad, linear-oblong, acute, serrulate, strongly arcuate, 1-nerved. Lip unguiculate; lamina 2.5–3 mm. long and 2–2.5 mm. broad, cordate to oblong-cordate, denticulate, fleshy, the surface obscurely verrucose or smooth, with a small central cavity near the base; claw short.

Endemic in Panama.

COCLÉ: hills north of El Valle de Antón, alt. about 1000 m., *Allen 2156;* same locality, *Allen 2194, 2267, 2701;* mountains beyond La Pintada, alt. about 400–600 m., *Hunter & Allen 594.*

Specimens of *Pleurothallis antonensis* have been referred to *P. phyllocardia* Reichb. f., a rather obscure and poorly described species.

9. PLEUROTHALLIS ARIETINA Ames, Sched. Orch. 4:16. 1923; loc. cit. 7: *t. 16.* 1924.

Caespitose epiphytic herbs up to 3.5 dm. tall. Secondary stems up to 2.5 dm. long, slender, ancipitous or winged, at least when dry, with one or more basal sheaths, naked above. Leaves 6–13 cm. long and 1.5–3.5 cm. broad, lanceolate to ovate-lanceolate, acute or acuminate, cordate at the base when mature, coriaceous. Inflorescence a fascicle of 1–several, rather long-pedicellate flowers, shorter than the leaves. Dorsal sepal 9–10 mm. long and 2.5–4 mm. broad, oblong to oblong-lanceolate, obtuse, cucullate, fleshy. Lateral sepals 9–10 mm. long and together 2–4 mm. broad, oblong or oblong-lanceolate, obtuse, cucullate, fleshy, connate to their apices. Petals 7–10 mm. long and 1.4–1.8 mm. broad, linear-oblong or linear-lanceolate, obtuse, attenuated into a thin claw at the base, the apical half semi-terete. Lip 1.5–2.5 mm. long and 2–3 mm. broad when expanded, triangular-crescentiform and with two linear-lanceolate arms at the base, the

Fig. 99. *Pleurothallis arietina*

whole when spread out suggesting a ram's head.

Costa Rica and Panama.

CHIRIQUÍ: Cerro Horqueta, alt. 1500–1660 m., *Powell 288.* COCLÉ: mountains beyond La Pintada, alt. 400–600 m., *Hunter & Allen 595.*

10. PLEUROTHALLIS HOMOLANTHA Schltr. in Fedde Rep. Sp. Nov. Beih. 19:106. 1923.

Pleurothallis nemorum Schltr. loc. cit. 191.

Small, caespitose, epiphytic herbs up to about 3.5 dm. tall. Secondary stems up to about 23 cm. long, slender, with one or more sheaths toward the base, naked above. Leaves 3.5–10 cm. long and 0.9–3.5 mm. broad, elliptic-lanceolate to ovate, cordate at the base, acute or acuminate. Inflorescence a fascicle of 1–few flowers, much shorter than the leaves. Dorsal sepal 6–10 mm. long and 3–4.5 mm. broad, elliptic-oblong to elliptic-obovate, acute. Lateral sepals connate to their apices, 6–10 mm. long and 3.5–6 mm. broad, lanceolate-ovate to ovate, acute, somewhat cucullate. Petals 3.5–5 mm. long and 0.5–1 mm. broad, elliptic-linear, acute, arcuate, glabrous. Lip unguiculate; lamina 2–3.5 mm. long and 1.5–3 mm. broad, oblong-cordate, obtuse (rarely acutish), fleshy.

Costa Rica and Panama.

CHIRIQUÍ: valley of the upper Río Chiriquí Viejo, *White & White 80.* COCLÉ: El Valle, alt. 600–1000 m., *Allen 1236.*

11. PLEUROTHALLIS SIMULANS L. Wms. in Ann. Missouri Bot. Gard. 27:281, *pl. 33, figs. 8-10.* 1940.

Small, caespitose, epiphytic herbs up to about 10 cm. tall. Secondary stems 2.5–6 cm. long, slender, usually a little longer than the leaves, with one or two sheathing bracts at the base. Leaves 3–5 cm. long and 0.5–0.8 cm. broad, ligulate to elliptic-oblanceolate, obtuse, coriaceous, submarginate. Inflorescence 1-flowered or a few-flowered fascicle, shorter than the subtending leaf. Dorsal sepal about 10 mm. long and 3.5–4 mm. broad, lanceolate, acuminate. Lateral sepals connate to their apices, about 10 mm. long and 4.5–5 mm. broad, broadly lanceolate, acuminate. Petals 5–6 mm. long and 2–2.5 mm. broad, broadly elliptic to subrhombic, acute or acuminate, lacerate-ciliate nearly to the base. Lip 3–3.5 mm. long and 2–2.5 mm. broad, simple, subcordate in outline, acuminate, the anterior margin somewhat serrulate, the disc covered with a thick callus simulating that found in species of *Stelis;* the callus with an anterior rim, an inconspicuous depression toward its apex and sharply declined to the attachment of the lip.

Panama.

COCLÉ: north rim of El Valle de Antón, *Allen 1912;* trail to Las Minas, hills north of El Valle de Antón, *Allen 2749.*

An interesting and conspicuous species of *Pleurothallis* because of the unusual structure of the lip.

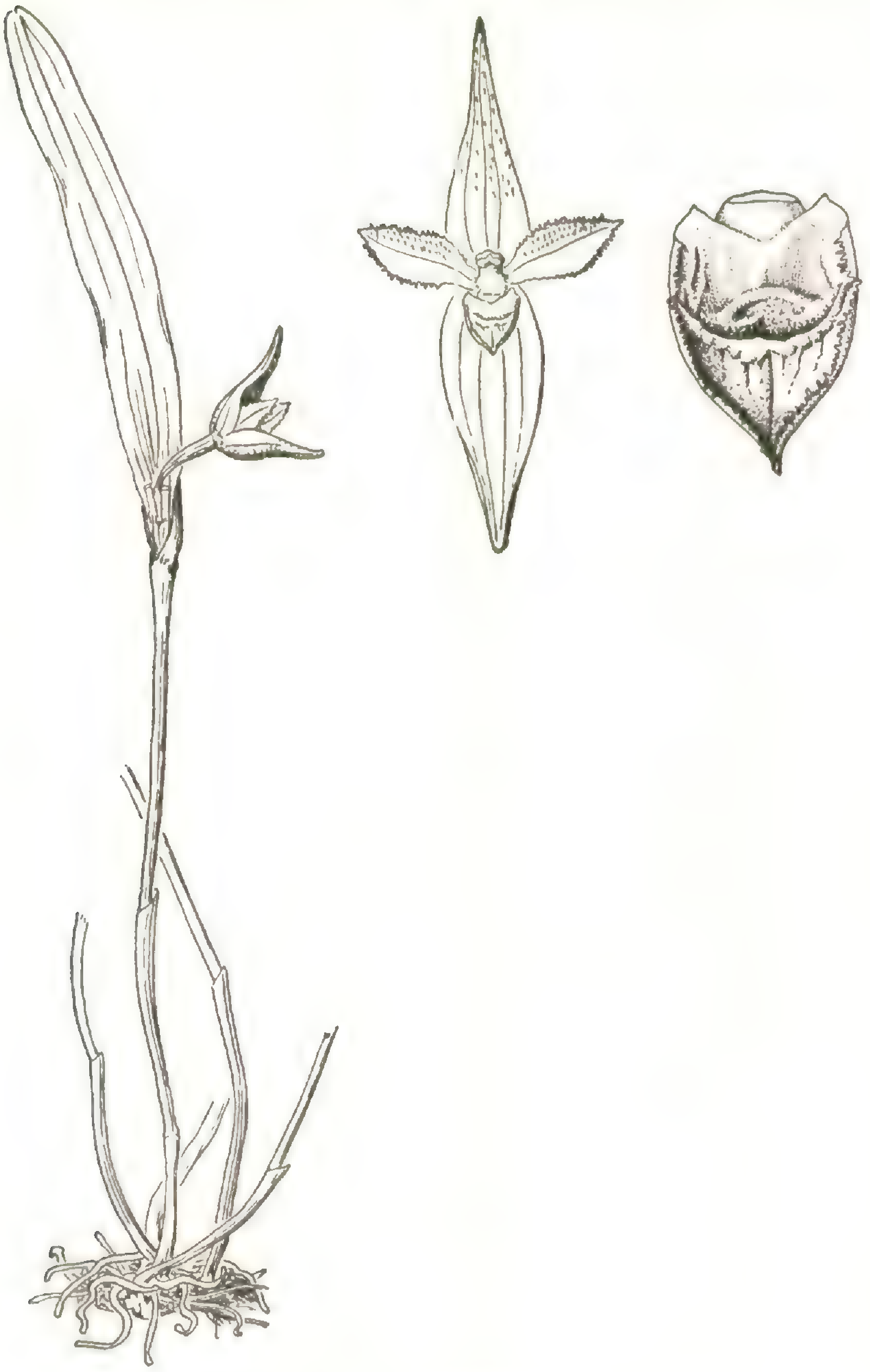


Fig. 100. *Pleurothallis simulans*

12. Pleurothallis concaviflora C. Schweinf. in Bot. Mus. Leafl. Harv. Univ. 4:114. 1937; L. Wms. in Ann. Missouri Bot. Gard. 28:416. 1941.

Small, caespitose, epiphytic herbs up to about 11 cm. tall. Secondary stems up to about 7 cm. long, slender. Leaves 2.5–4 cm. long and 0.7–1.5 cm. broad, elliptic-oblong, obtuse or acute, coriaceous. Inflorescence a fascicle of 1- to several-flowered peduncles. Sepals obscurely puberulent or glabrous within. Dorsal sepal 4–5 mm. long and 2.5–3.3 mm. broad, oblong-ovate to oblong-obovate, acute or obtuse, cucullate, fleshy. Lateral sepals connate to their apices, about 4.5 mm. long and 4–5 mm. broad, ovate-suborbicular to suborbicular, cucullate, obtuse or acute. Petals 1.7–2.5 mm. long and 0.6–0.9 mm. broad, linear-oblong to elliptic-oblong, acute or obtuse. Lip 2–2.5 mm. long and 1–1.5 mm. deep, 3-lobed or at least the base produced into prominent retrorse auricles, saccate-

concave, apiculate at the apex; lateral lobes or auricles retrorse or erect, triangular-lanceolate; the disc with a callus connecting the bases of the lobes or auricles.

Costa Rica and Panama.

COCLÉ: vicinity of El Valle de Antón, alt. about 600 m., *Allen 2058;* vicinity of La Mesa, alt. about 1000 m., *Allen 2317.*

This species seems to differ from *P. excavata* Schltr. only in having slightly smaller flowers. No material of *P. excavata* is available for study. The types of the two units are from the same locality in Costa Rica.

13. PLEUROTHALLIS COBRAEFORMIS L. Wms. in Ann. Missouri Bot. Gard. 27:277, *pl. 34, figs. 7-14.* 1940.

Small, caespitose, epiphytic herbs up to about 13 cm. tall. Secondary stems mostly up to 4–6 cm. long, slender, subequal to the leaves or a little longer.

Fig. 101. *Pleurothallis cobraeformis*

Leaves 4–6 cm. long and 0.8–1.1 cm. broad when mature, obtuse or acute, fleshy. Inflorescence a 1- to several-flowered fascicle (or possibly an abbreviated raceme?), much shorter than the leaves. Dorsal sepal 8–10 mm. long and 7–9 mm. broad, suborbicular, subacute, strongly cucullate. Lateral sepals connate to their apices, about 6–7 mm. long and 4.5–5 mm. broad, broadly oval. Petals 4–6 mm. long and 1.2–2.5 mm. broad, elliptic, acute, arcuate, dentate-ciliate. Lip about 3.5 mm. long and as broad, short-clawed; lamina apiculate, broadly cordate, fleshy,

Fig. 102. *Pleurothallis Allenii*

sharply deflexed, the basal auricles rounded.

Panama.

COCLÉ: vicinity of El Valle de Antón, alt. about 600 m., *Allen 2057*.

14. PLEUROTHALLIS ALLENII L. Wms. in Ann. Missouri Bot. Gard. 27:275, *pl. 33, figs. 5-7*. 1940.

Small, caespitose, epiphytic herbs up to about 15 cm. tall. Secondary stems 3–6 cm. long, slender, shorter than the leaves, with one or two sheaths at the base. Leaves 5–9 cm. long and 0.3–0.6 cm. broad, ligulate to linear-ligulate, obtuse or tridentate, coriaceous. Inflorescence a 1- to several-flowered fascicle, shorter than the leaves, the flowers large for the size of the plant. Dorsal sepal about 15 mm. long and 4 mm. broad, lanceolate, long attenutate-acuminate. Lateral sepals connate nearly to their apices, about 15 mm. long and together about 5 mm. broad, lanceolate, acute. Petals about 12 mm. long and 3 mm. broad, lanceolate, acute or acuminate, slightly oblique. Lip about 4 mm. long and as broad, 3-lobed; the lateral lobes erect, about 1.25 mm. long and 1 mm. broad, broadly oblong, the apices rounded; the mid-lobe about 2 mm. long and 1.5 mm. broad at the base, narrowly triangular, acute; disc very fleshy, with a tripartite raised callus near the middle, and the mid-lobe covered with echinulate protuberances.

Panama.

COCLÉ: vicinity of El Valle de Antón, alt. 600–1000 m., *Allen 1240*; vicinity of La Mesa, alt. about 1000 m., *Allen 2338*.

15. PLEUROTHALLIS TRACHYCHLAMYS Schltr. in Fedde Rep. Sp. Nov. Beih. 17:23. 1922; Ames, Sched. Orch. 7:31, *t. 19*. 1924.

Small, repent, epiphytic herbs. Secondary stems up to about 6 cm. long, covered with scarious sheaths which are scurfy or at least verrucose. Leaves 4.5–7 cm. long and 0.4–1 cm. broad, elliptic to lanceolate, acute. Inflorescence a 1- to few-flowered fascicle. Dorsal sepal 4–5 mm. long and 1.5–1.8 mm. broad, ovate or oblong-lanceolate, acute. Lateral sepals 4–5 mm. long and about 1.5 mm. broad, free to the bases, oblong-lanceolate, acute. Petals about 4 mm. long and 1.5 mm. broad, lanceolate and abruptly expanded near the bases. Lip about 2 mm. long and 1 mm. broad, oblong-oval, obtuse, with 2 small, erect, lateral lobes near the middle, with a small callus at the base.

Costa Rica (?), Panama, and dubiously in Peru.

PANAMÁ: foothills east of Panama City, *Powell 215*.

16. PLEUROTHALLIS EUMECOCAULON Schltr. in Fedde Rep. Sp. Nov. Beih. 19:187. 1923; L. Wms. in Ann. Missouri Bot. Gard. 27:277. 1940.

Small, caespitose, epiphytic herbs up to about 2 dm. tall. Secondary stems slender, strict, with one or two sheaths. Leaves 2.5–7.5 cm. long and 0.4–1.3 cm. broad, linear, elliptic or usually lanceolate, acute, coriaceous. Inflorescence a fascicle of long (2–3 cm.)-pedicellate flowers; one or more short, scarious bracts

at the base. Dorsal sepal 5–7 mm. long and 2.5–3.5 mm. broad, lanceolate to ovate-lanceolate, acute or acuminate, cucullate. Lateral sepals connate to their apices, 4.5–5.5 mm. long and 2.5–3.5 mm. broad, broadly lanceolate to ovate-lanceolate, obtuse or acute, fleshy. Petals 4.5–5 mm. long and about 1–1.5 mm. broad, linear-lanceolate to lanceolate, acuminate, papilliferous, the acumination subterete. Lip 3–3.5 mm. long and 1.5–2 mm. broad, papilliferous to subciliate, lanceolate to oblong-ovate, acute, truncate at the base, slightly constricted above the middle, fleshy, with a small V-shaped excavation above the middle and with 3 raised lines on the dorsal surface.

COCLÉ: vicinity of El Valle, alt. 600–1000 m., *Allen 1237;* hills north of El Valle de Antón in the vicinity of La Mesa, alt. 1000 m., *Allen 2339.*

17. PLEUROTHALLIS RUSCIFOLIA (Jacq.) R. Br. in Aiton, Hort. Kew. ed. 2, 5:211. 1813; Ames in Bot. Mus. Leafl. Harv. Univ. 1^9: *t. p. 5.* 1933.

Epidendrum ruscifolium Jacq. Enum. Pl. Carib. 29. 1760.
Dendrobium ruscifolium Sw. in Nova Acta Soc. Sci. Upsala 6:84. 1799.
Pleurothallis glomerata Ames, Sched. Orch. 4:21. 1923; loc. cit. 7: *t. 10.* 1924.

Caespitose, epiphytic herbs up to about 5 dm. tall but usually much smaller. Secondary stems up to about 4 dm. long, slender. Leaves 4–20 cm. long and 1–5 cm. broad, linear-lanceolate to elliptic to lanceolate-ovate, acute or acuminate, contracted into a short cucullate petiole at the base. Inflorescence a 1- to many-flowered fascicle. Dorsal sepal 6–10 mm. long and 1.3–3 mm. broad, narrowly to broadly lanceolate, cucullate. Lateral sepals 6–10 mm. long and together 2.5–3 mm. broad, lanceolate to ovate-lanceolate, cucullate, acuminate, connate to their apices. Petals 4–8 mm. long and 0.31 mm. broad, subfiliform to narrowly lanceolate, acute. Lip 1.5–2 mm. long and about 1.2–1.4 mm. broad, ovate to oblong-cordate or ovate-cordate, acute or acuminate.

Costa Rica and Panama, the West Indies, and South America. Reported from Guatemala and Salvador.

CHIRIQUÍ: Bajo Chorro, alt. 1800 m., *Davidson 262.* COCLÉ: hills north of El Valle de Antón, alt. 800–1000 m., *Allen 2269;* trail to Las Minas, hills north of El Valle de Antón, alt. 1000 m., *Allen 2872.*

This variable and widespread species is the generic type of *Pleurothallis.*

18. PLEUROTHALLIS OCTOMERIAE Schltr. in Fedde Rep. Sp. Nov. Beih. 17:21. 1922.

Pleurothallis cerea Ames, Sched. Orch. 4:19. 1923; loc. cit. 7:26, *fig. 4* and *t. 8.* 1924.

Erect, caespitose, epiphytic herbs up to about 5 dm. tall. Secondary stems up to about 3 dm. long and 0.4 cm. in diameter, covered with closely appressed sheaths which may be scurfy, the sheaths disintegrating with age. Leaves 4–20 cm. long and 0.8–6 cm. broad, narrowly elliptic to broadly lanceolate, acute or obtuse, coriaceous. Inflorescence a few- to many-flowered fascicle. Dorsal sepal 5.5–8 mm. long and 2–3 mm. broad, lanceolate to oblong-lanceolate, obtuse. Lateral sepals 4.5–7 mm. long and 2–2.8 mm. broad, broadly lanceolate, obtuse

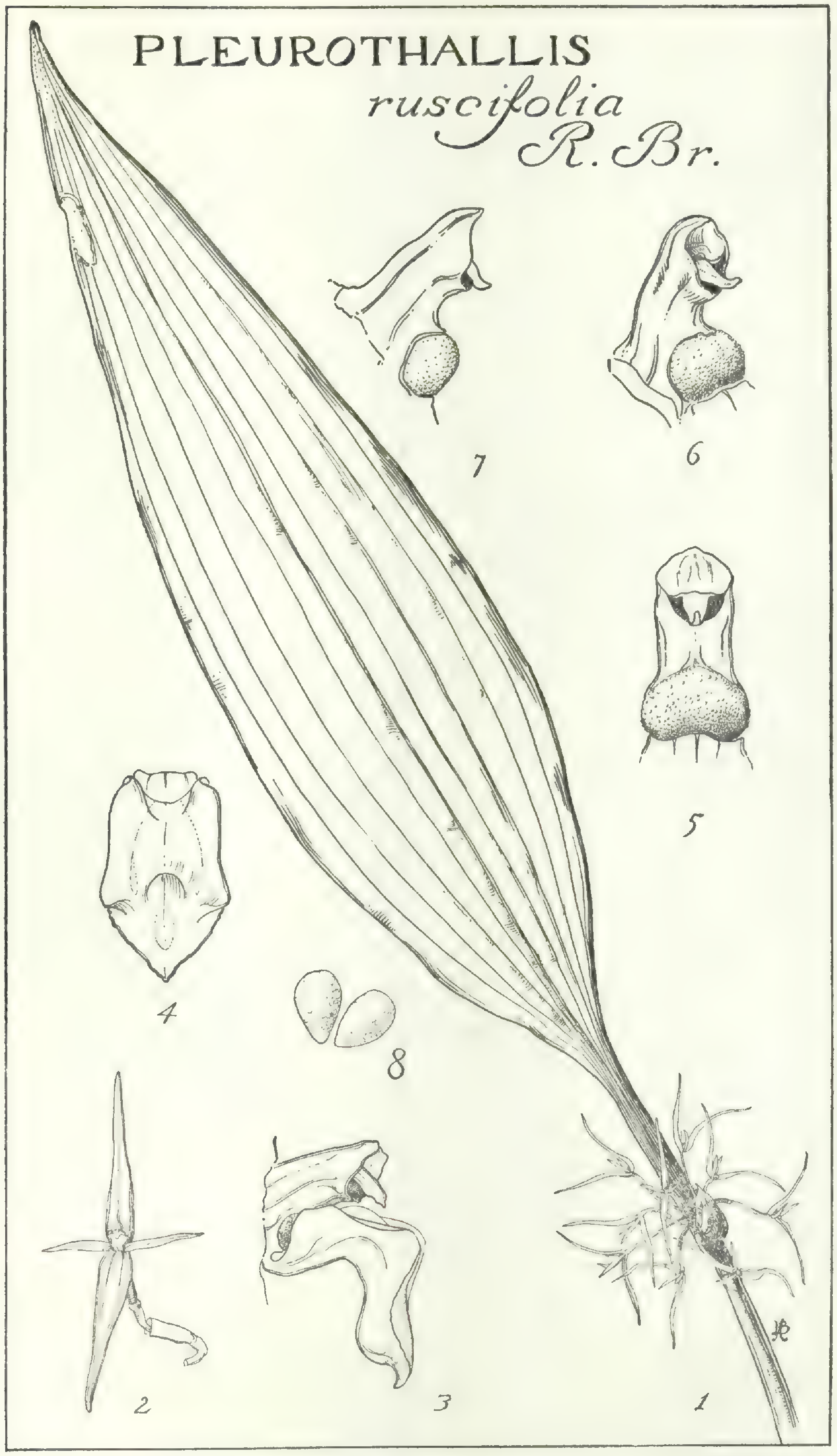


Fig. 103. *Pleurothallis ruscifolia*

or acute, usually arcuate, connate at the base and forming a short mentum. Petals 4–8 mm. long and 1.5–2.2 mm. broad, lanceolate, obtuse or acute, somewhat arcuate. Lip 2–3 mm. long and 0.8–1.3 mm. broad, oblong to oblong-ovate, obtuse, short-clawed, with 2 submarginal, elongated, sublamellate calluses which are about as long as the lip.

Costa Rica and Panama; possibly also Honduras.

CHIRIQUÍ: "Province of Chiriquí," *Powell 252, 3432*. COCLÉ: hills north of El Valle de Antón, alt. 1000 m., *Allen 2719*. PANAMÁ: hills above Campana, alt. 600–800 m., *Allen 1881*.

Allen 2719 consists of a fine series of plants which show that *P. cerea* is only a robust phase of *P. octomeriae*.

19. PLEUROTHALLIS UNCINATA Fawc. in Jour. Bot. 33:12. 1895; Fawc. & Rendle, Fl. Jam. 1:63, *t. 10*. 1910; C. Schweinf. in Bot. Mus. Leafl. Harv. Univ. 7:151. 1939.

Pleurothallis Alexandrae Schltr. in Fedde Rep. Sp. Nov. Beih. 19:103. 1923.

Tall, rather coarse, subcaespitose, epiphytic herbs up to 5.5 dm. tall. Secondary stems up to about 3.5 dm. long, covered with several loose, ancipitous, chartaceous sheaths which soon disintegrate. Leaves 8–22 cm. long and 1–5 cm. broad, linear-elliptic to oblong-lanceolate, acute, coriaceous. Inflorescence a 1- to few-flowered fascicle with the flowers on long pedicels. Dorsal sepal 10–20 mm. long and 4–6 mm. broad, linear-oblanceolate to oblong, acute or obtuse, puberulent dorsally. Lateral sepals 12–20 mm. long and 3–4 mm. broad, linear-lanceolate to oblong-lanceolate, acute, puberulent on both sides. Petals 5–9 mm. long and 1.3–2.5 mm. broad, oblanceolate, acuminate, denticulate above, 3-nerved. Lip 6–8 mm. long and 2.5–3 mm. broad, oblong-ovate, usually subpandurate, obtuse, with two narrow, falcate lateral lobes above the base, typically with thick calluses near the base of the lateral lobes and without a retrorse callus at the base. (Cf. note below.)

Costa Rica, Panama, and the West Indies.

CHIRIQUÍ: Boquete, alt. about 1800 m., *Davidson 220* (sterile specimen). COCLÉ: Valle de Antón, alt. about 800 m., *Cope s. n.*

Schweinfurth, loc. cit., has reduced *P. Alexandrae* Schltr. to *P. uncinata* without comment. Adequate material may prove that it is distinct and that the Cope specimen should be referred there. The lip on the Cope specimen is relatively small, has a prominent retrorse callus at the base (which typical *P. uncinata* lacks), and is membranaceous at the base of the side lobes (while in *P. uncinata* a large callus is situated at the base of each of the side lobes).

20. PLEUROTHALLIS TRIBULOIDES (Sw.) Lindl. Gen. & Sp. Orch. Pl. 6. 1930.

Epidendrum tribuloides Sw. Nov. Gen. & Sp. Pl. Prodr. 123. 1788.
Pleurothallis fallax Reichb. f. in Bonplandia 3:224. 1855.
Cryptophoranthus acaulis Kränzl. in Fedde Rep Sp. Nov. Beih. 34:232. 1925.

Small, caespitose, epiphytic herbs up to 8 cm. tall. Secondary stems about 1

cm. long, covered with loose, chartaceous bracts, slender. Leaves 2–7 cm. long and 0.4–1.4 cm. broad, narrowly to broadly oblanceolate, obtuse, attenuated into a petiole at the base, coriaceous. Inflorescence a fascicle of 1–few brick-red flowers. Dorsal sepal 5–7 mm. long and 2–2.2 mm. broad, oblong-lanceolate or oblong-oblanceolate, acute, papilliferous, constricted just above the base. Lateral sepals often connate to their apices, 4.5–7.5 mm. long and about 3 mm. broad, oblong or oblong-lanceolate, acute, cucullate, papilliferous. Petals 2.5–3 mm. long and 1.2–1.4 mm. broad, oblong-oblanceolate, oblique, lobulate, acute, fleshy especially toward the apex. Lip 2.5–3 mm. long and 0.7–1.5 mm. broad, oblong or oblong-lanceolate, lobulate below the middle, obscurely ciliate toward the apex. Capsule echinate.

Mexico, British Honduras, Guatemala, Honduras, Costa Rica, Panama, and the West Indies.

CHIRIQUÍ: banks of Caldera River, alt. 1360 m., *Powell 237, 3376.*

21. PLEUROTHALLIS HISPIDA L. Wms. in Ann. Missouri Bot. Gard. 27:277, *pl. 33, figs. 1-4.* 1940.

Cryptophoranthus Powellii Ames, Sched. Orch. 4:8. 1925, non *Pleurothallis Powellii* Schltr.

Small, caespitose, epiphytic herbs up to about 5 cm. tall. Secondary stems 0.5–2 mm. long, shorter than the leaves, with 2 or 3 cauline bracts, the upper infundibuliform, maculate with maroon dots and hispid at least along the angles. Leaves 1–3.5 cm. long and 0.3–1.3 mm. broad, narrowly elliptic to elliptic-oval, obtuse, coriaceous, margins hispid or hispidulous. Inflorescence a one- to few-flowered fascicle. Dorsal sepal connate with the laterals for half its length, 5–6 mm. long, lanceolate, acute, hispidulous dorsally. Lateral sepals about 6 mm. long and together about 6 mm. broad, connate to their tips, strongly cucullate, in natural position calceolate, carinate, hispidulous dorsally and papillose within. Petals about 4 mm. long and 1 mm. broad, linear-oblong, the apex obliquely truncate and acute. Lip about 3 mm. long and 1.5 mm. broad, unguiculate; lamina oblong-lanceolate, with a lamellate callus extending from each lateral

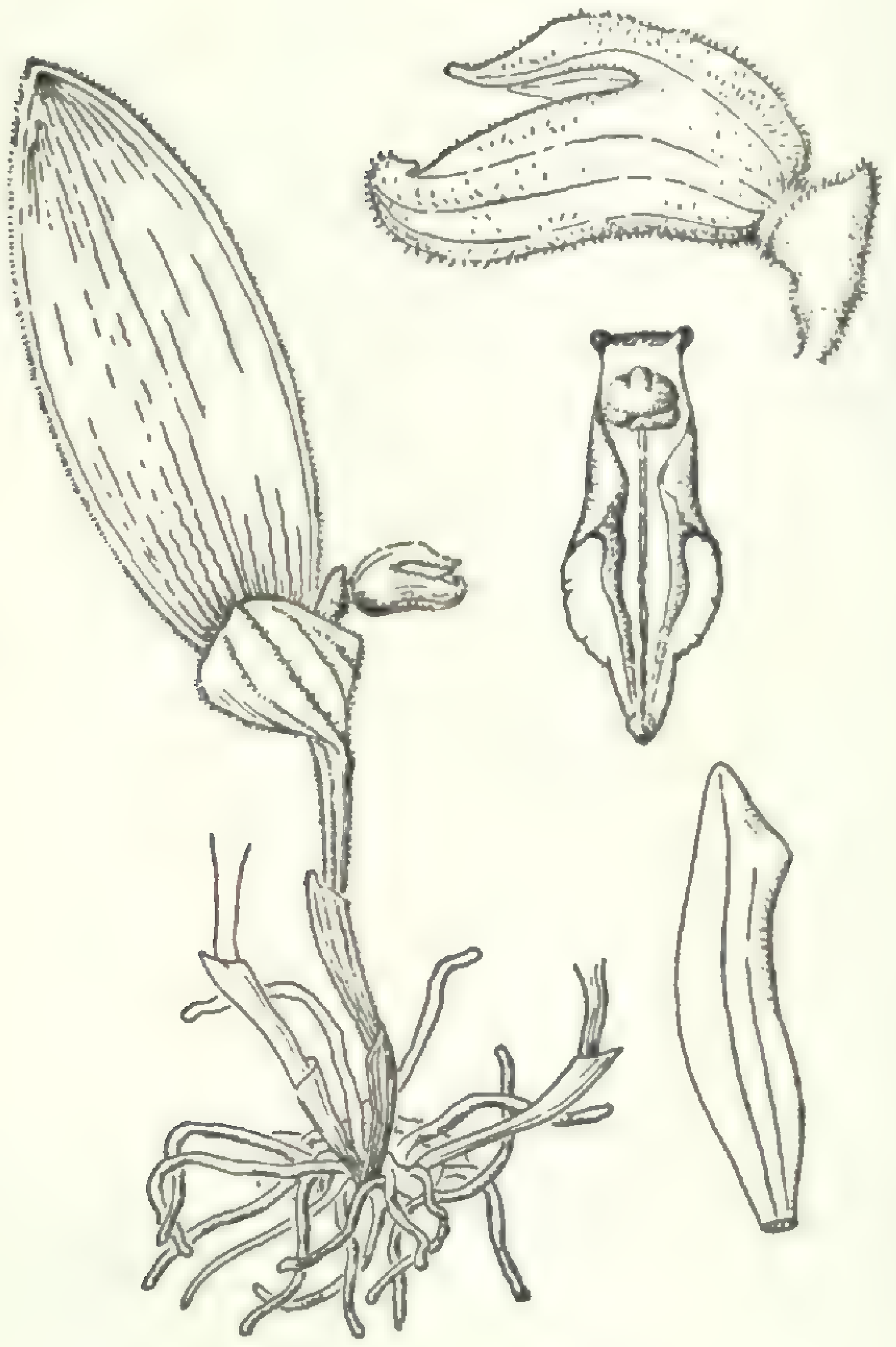


Fig. 104. *Pleurothallis hispida*

angle toward the apex and with a mammillate callus at the junction of the lamina and the claw, apical margins entire or denticulate; claw about 0.5 mm. long, minutely biauriculate at the base.

Endemic in Panama.

COCLÉ: vicinity of El Valle, alt. 600–1000 m., *Allen 782, 1243.* PANAMÁ: San Juan, *Powell 278.*

22. PLEUROTHALLIS BRIGHAMII S. Wats. in Proc. Am. Acad. 23:285. 1888; Ames, Sched. Orch. 7:19, *t. 7.* 1924.

Pleurothallis barboselloides Schltr. in Fedde Rep. Sp. Nov. Beih. 17:18. 1922; loc. cit. 59: *t. 29, fig. 113.* 1931.

Pleurothallis periodica Ames, loc. cit. 7:21, *t. 4.* 1924.
Pleurothallis acrisepala Ames & Schweinf. Sched. Orch. 8:22. 1925.

Fig. 105. *Pleurothallis Brighamii*

Small, caespitose, epiphytic herbs up to 12 cm. tall. Secondary stems up to about 6 mm. long, very short and inconspicuous, enclosed by sheaths. Leaves 1.8–9 cm. long and 0.3–1.2 cm. broad, oblanceolate to linear-oblanceolate, obtuse or acute, attenuated to the base, coriaceous. Inflorescence a 1- to several-flowered fascicle borne on a long slender peduncle, up to 12 cm. long, subequal to or exceeding the leaves. Flowers small, opening one at a time. Sepals connate for a short distance at the base; dorsal sepal 6–10 mm. long and 1.2–3 mm. broad, elliptic to oblong-lanceolate, obtuse to acuminate. Lateral sepals 6–9 mm. long and together 3–4.5 mm. broad, oblong to oblong-ovate, connate to the middle or beyond, acute. Petals 2–3.5 mm. long and 0.75–1.7 mm. broad, obliquely spatulate to obliquely oval, the anterior margin produced, acute or acuminate. Lip 2.1–4 mm. long and 0.8–2 mm. broad, oblong-ligulate to oblong-lanceolate, obtuse, the apex ciliate or denticulate, with an auriculate lateral lobe on either side near the base of the lamina, claw with a prominent callus.

A not uncommon plant at low elevations from Guatemala to Panama.

BOCAS DEL TORO: without locality, *Wedel 185;* Isla Colón, *Wedel 486.* CANAL ZONE: Barro Colorado Island, *Kenoyer 256, Shattuck 205, 567;* drowned forest between Tumba Vieja and Salamanca, *Steyermark & Allen 16750;* Salamanca Hydrographic Station, *Woodson, Allen & Seibert 1585;* hills east of or near Panama City, alt. near sea-level, *Powell 92, 219;* Gatún Lake, *Powell 275.* DARIÉN: vicinity of El Real, alt. about 15 m., *Allen 943.* PANAMÁ: Río La Maestra, alt. 0–25 m., *Allen 54;* Río Tecúmen, north of Chepo Road, alt. about 30 m., *Hunter & Allen 225;* near Tapia River, Juan Díaz region, *Maxon & Harvey 6699;* Casa Ladre, San Juan, hills east of Panama City, *Powell 274, 275, 420, 3508.*

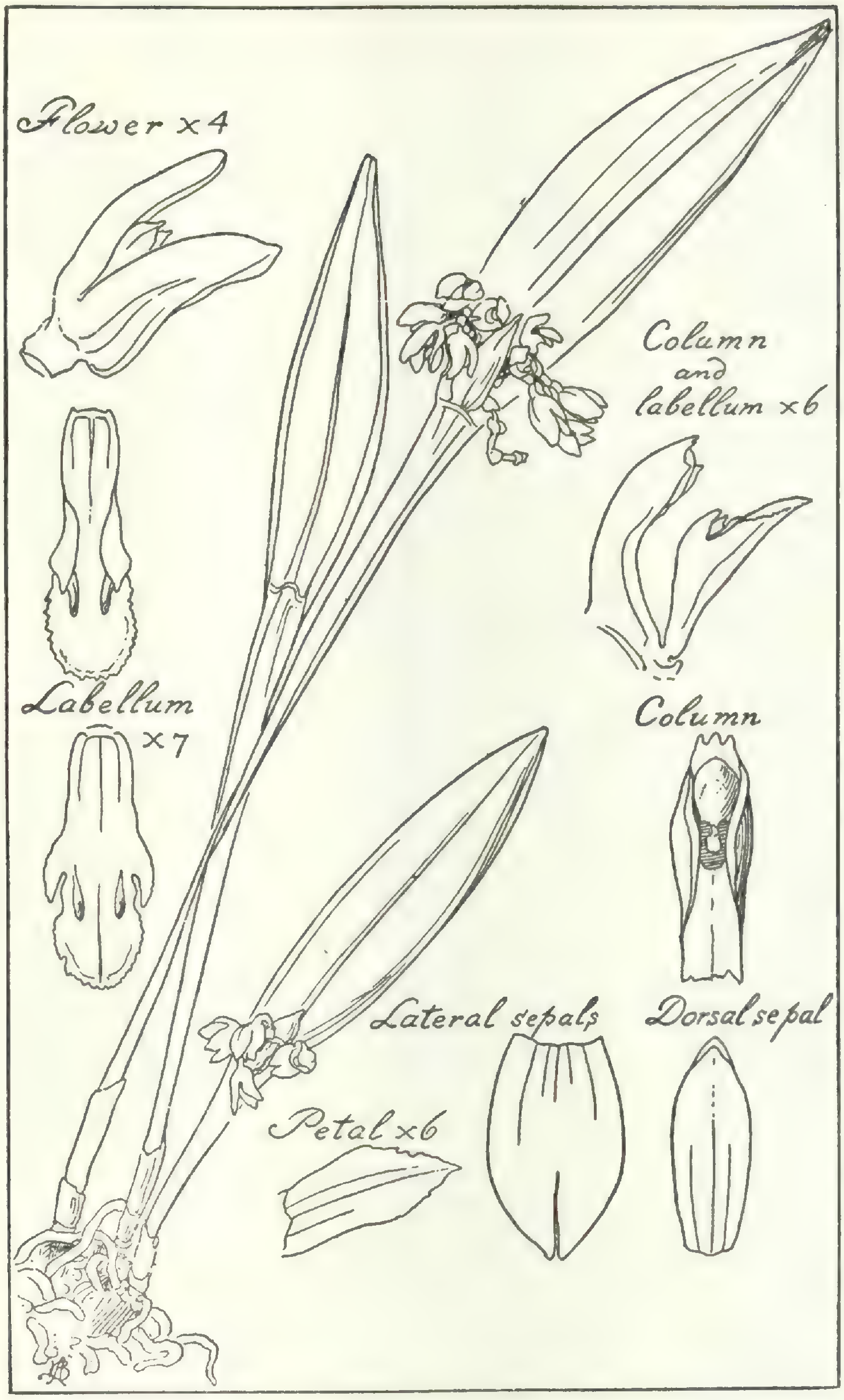


Fig. 106. *Pleurothallis alpina*

Pleurothallis Brighamii is a variable species which may eventually prove to be the same as *P. pyrsodes* Reichb. f.

23. PLEUROTHALLIS FULGENS Reichb. f. in Gard. Chron. n. s. 4:516. 1875.

Small, caespitose, epiphytic herbs up to about 10 cm. tall. Secondary stems up to about 1 mm. long. Leaves 4–8.5 cm. long and 1–1.8 cm. broad, elliptic to broadly oblanceolate, attenuated into a petiole at the base. Inflorescence a single

flower or a few-flowered fascicle borne on a long slender peduncle, about as long as or exceeding the leaves. Dorsal sepal 8–9 mm. long and about 3.5 mm. broad, ovate-lanceolate, acuminate, somewhat cucullate. Lateral sepals 10–12 mm. long, connate nearly to the middle, the bases gibbous; free part of the sepals about 6–7 mm. long and 3 mm. broad, lanceolate, acute or acuminate. Petals about 4 mm. long and 1.5 mm. broad, sublanceolate but oblique, produced anteriorally into an auricle at the middle, acute. Lip about 5 mm. long and 2.5 mm. broad, elliptic, obtuse, with a pair of small, erect, lateral lobes below the middle and a pair of parallel, submarginal, lamellate calluses near the middle.

Costa Rica and Panama.

CHIRIQUÍ: Cerro Horqueta, alt. 1200–1500 m., *Powell 335, 340.*

The description is based on a record of the type and the specimen cited. Specimens from Costa Rica which have been referred here are very much larger, have relatively short inflorescences, and show slight floral differences.

24. PLEUROTHALLIS GLANDULOSA Ames, Sched. Orch. 6:60. 1923.

Pleurothallis vittariifolia Schltr. in Fedde Rep. Sp. Nov. Beih. 19:26. 1923.

Small, caespitose, epiphytic herbs up to about 5 cm. tall. Secondary stems 1 mm. long or less. Leaves 1.5–2.5 cm. long and 0.1–0.2 cm. broad, obtuse, attenuated to the base. Inflorescence a single flower or a few-flowered fascicle; peduncle slender, puberulent, up to about 4 cm. long, exceeding the leaves. Pedicel and ovary up to about 1 cm. long, puberulent. Dorsal sepal 6–9 mm. long and about 1.5 mm. broad, linear-lanceolate, acute or acuminate, puberulent and lightly keeled dorsally. Lateral sepals 6–8 mm. long and together about 2.5 mm. broad, connate to about the middle, gibbous at the base, puberulent and lightly keeled dorsally. Petals about 3 mm. long and 1.3 mm. broad, subdolabriform, cuneate at the base, oblique, apiculate. Lip about 3.5 mm. long and 1 mm. broad, unguiculate; lamina subpandurate and auriculate at the base, glandular-puberulent on the margin and upper surface.

Costa Rica and Panama.

CANAL ZONE: near Vigía and San Juan, *Dodge, Steyermark & Allen 16578.* PROVINCE NOT KNOWN (PANAMÁ OR CANAL ZONE?): Juna Grande Range, alt. near sea-level, *Powell 306, 3430;* without data, *Purdom.*

25. PLEUROTHALLIS ALPINA Ames, Sched. Orch. 5:14, *fig. 3.* 1923.

Caespitose epiphytic herbs up to about 4 dm. tall. Secondary stems slender, up to about 3 dm. long, prominently 2- or 3-alate, expanded at the apex and the wings passing into the leaves. Inflorescence a raceme or fascicle of racemes, few-flowered, short, not half as long as the leaf. Leaves 5–12 cm. long and 0.6–2.5 cm. broad, ligulate to elliptic-lanceolate or elliptic-oblanceolate, acute or obtuse, coriaceous. Sepals acute, fleshy, obscurely puberulent dorsally; dorsal sepal 6–6.5 mm. long and 1.5–2.5 mm. broad, elliptic to oblong-oblanceolate, cucullate; lateral sepals 5–6 mm. long and 1.5–2 mm. broad, lanceolate, arcuate. Petals about 2.5 mm. long and 1–1.2 mm. broad, elliptic-oblong, acute, serrulate, arcuate. Lip 2.5–4.5 mm. long and 1.5–2 mm. broad, elliptic-oblong, obtuse, with two

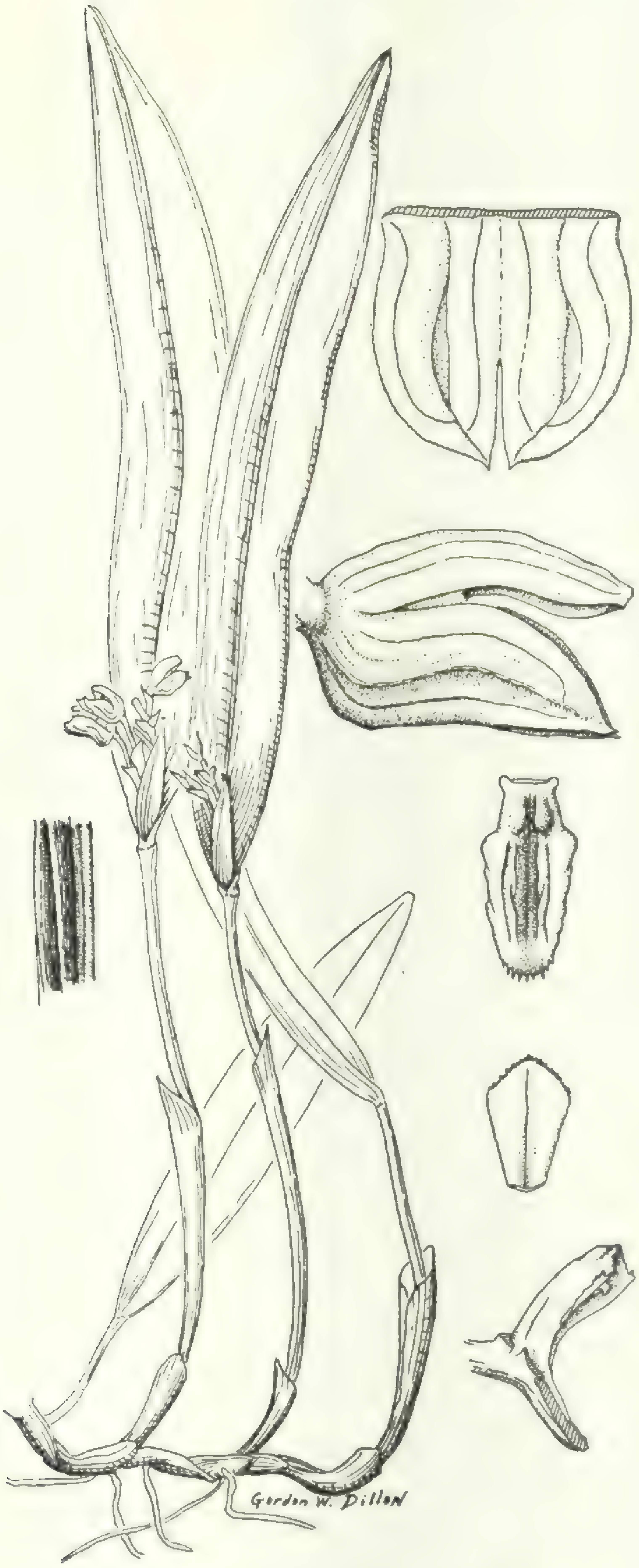


Fig. 107. *Pleurothallis pterocaulis*

small lanceolate-arcuate lateral lobes about 0.5 mm. long near the middle, apex fimbriate, with two carinate, longitudinal calluses near the middle of the disc.

Costa Rica and Panama.

CHIRIQUÍ: Caramillia, alt. 1360 m., *Powell 282.* COCLÉ: vicinity of El Valle, alt. 600–1000 m., *Allen 1238;* hills north of El Valle de Antón, alt. about 800–1000 m., *Allen 2289.*

A not uncommon species which is allied to *P. sicaria* Lindl.

26. PLEUROTHALLIS PTEROCAULIS L. Wms. in Ann. Missouri Bot. Gard. 27:280, *t. 32, figs. 1-7.* 1940.

Repent epiphytic herbs up to about 16.5 cm. tall. Secondary stems 2.5–7 cm. long, winged or strongly angled (at least when dry), shorter than the leaves. Leaves 4–11 cm. long and 1–1.5 cm. broad, elliptic to elliptic-lanceolate, acute, coriaceous. Inflorescence a fascicle of one- to few-flowered racemes, shorter than the leaves. Dorsal sepal about 6 mm. long and 2–2.5 mm. broad, oblong-lanceolate, strongly cucullate, carinate with the apex thickest. Lateral sepals connate for about half or more their length, 5–6 mm. long and together about 5 mm. broad, each sepal oblong-lanceolate, somewhat oblique, acute, carinate and with a thicker carinate cushion near the outer margins. Petals about 2.5 mm. long and 1.7 mm. broad, subrhombic-obovate, the apical margin serrulate. Lip about 4 mm. long and 1.5 mm. broad, unguiculate, oblong-lanceolate, obtuse, carinate, with two inconspicuous calluses at the junction of the lamina and the claw, the claw inconspicuously biauriculate at the base.

Endemic in Panama.

COCLÉ: vicinity of El Valle de Antón, alt. 600–1000 m., *Allen 1239.*

Originally said to be closely allied to *P. hondurensis* Ames, it is probably more closely allied to *P. verecunda* Schltr.

27. PLEUROTHALLIS VERECUNDA Schltr. in Fedde Rep. Sp. Nov. Beih. 17:24. 1922.

Erect, repent, epiphytic herbs up to about 3.5 dm. tall. Secondary stems up to about 19 cm. long, terete or angled (at least when dry). Leaves 8.5–16 cm. long and 1–2.2 cm. broad, elliptic or lanceolate-ligulate, acute, coriaceous. Inflorescence a few-flowered raceme about half as long as the leaves. Dorsal sepal 5.5–7 mm. long and 1.5–2 mm. broad, lanceolate to oblong-lanceolate, acute. Lateral sepals 5.5–7 mm. long and each 1.5–2.5 mm. broad, lanceolate, acute, apex thickened, free nearly to the base. Petals 2.2–3.2 mm. long and 0.75–1 mm. broad, oblong-oblanceolate, oblique, apical half denticulate. Lip 3–3.5 mm. long and 1.5–2 mm. broad, oblong to oblong-ovate, obtuse, truncate at the shortly unguiculate base; lamina with two short auricles at the base, fleshy, with a submammillate callus at the apex of claw and two lateral callus thickenings.

Costa Rica and Panama.

CANAL ZONE: Río Indio, near mouth of Chagres River, alt. about sea-level, *Powell 91;* Barro Colorado Island, *Shattuck 722.*

Fig. 108. *Pleurothallis verecunda*

Fig. 109. *Pleurothallis lepidota*

28. Pleurothallis lepidota L. Wms. in Ann. Missouri Bot. Gard. 27:279, *pl. 32, figs. 8-12.* 1940.

Small, caespitose, epiphytic herbs up to about 2.2 dm. tall. Secondary stems about 9–12 cm. long, partially invested with 2–3 scarious sheaths. Leaves 7–10 cm. long and 3–3.5 cm. broad, elliptic to elliptic-lanceolate, short-acuminate. Inflorescence one or more few-flowered racemes, shorter than the leaves. Dorsal sepal 13–14 mm. long and about 2 mm. broad, linear-lanceolate, acute. Lateral sepals about 14 mm. long and together 12 mm. broad at their bases, subtriangular, connate nearly to their apices, acuminate or acute, carinate-winged along the mid-nerve dorsally, outer surface papilliferous. Petals about 5 mm. long and 0.25 mm. broad, linear, acute. Lip about 8 mm. long and 5 mm. broad, unguiculate, obscurely 3-lobed, upper surface lepidote-verrucose, with a mammillate callus at the junction of the lamina and the claw, margins serrulate to serrate; lateral lobes 2 mm. long and as broad, rounded; mid-lobe oblong-lanceolate, acute, about 4–5 mm. long and 2 mm. broad.

Panama.

chiriquí: Llanos del Volcán, alt. about 1300 m., *Allen 1552.*

29. Pleurothallis cogniauxiana Schltr. in Fedde Rep. Sp. Nov. 3:246. 1907.

Repent or caespitose epiphytic herbs up to about 3.2 dm. tall. Secondary stems up to about 19 cm. long, slender, naked or with 1–2 sheaths at the base, with 2–3 narrow but prominent wings. Leaves 8–15 cm. long and 3–9 cm. broad, elliptic-lanceolate to ovate-lanceolate. Inflorescence 1 or more short racemes up to half as long as the leaves. Dorsal sepal 9–11 mm. long and 3–4.5 mm. broad, elliptic-obovate, obtuse or acute, slightly verrucose within. Lateral sepals 5–7.5 mm. long and together 5–7 mm. broad, suborbicular, connate to their apices or nearly so, slightly verrucose within. Petals 3.5–4.5 mm. long and 1.5–2.4 mm. broad, lanceolate-subrhombic, acute, terminal half denticulate. Lip 4–5 mm. long and 2–3 mm. broad, subrhombic, unguiculate, with two inflexed auricles or lateral lobes below the middle and two auricles at the base of the claw, surface of the apical half verrucose and the margin denticulate, with 2 parallel callus thickenings near the middle.

Costa Rica and Panama.

chiriquí: vicinity of "New Switzerland," alt. 1800–2000 m., *Allen 1383;* Bajo Chorro, alt. 1800 m., *Davidson 109, 382.*

30. Pleurothallis vittata Lindl. in Bot. Reg. 24: Misc. p. 73. 1838; L. Wms. in Ann. Missouri Bot. Gard. 26:280. 1939.

Pleurothallis polystachya Rich. & Gal. in Ann. Sci. Nat. III, 3:16. 1845.
Pleurothallis mandibularis Kränzl. in Vid. Medd. Naturh. Foren. 71:169. 1920.
Pleurothallis Bourgeaui Kränzl. in Ark. f. Bot. 16^8:15. 1920.

Repent or caespitose epiphytic herbs up to about 2.5 dm. tall. Secondary stems up to 15 cm. long, prominently angled, at least when dry. Leaves 5–12 cm. long and 1–2.3 cm. broad, lanceolate to elliptic-ligulate, acute or obtuse,

coriaceous. Inflorescence 1–several short racemes, ⅔ as long as the leaves or less. Sepals densely puberulent dorsally; dorsal sepal 5–8 mm. long and 1.5–2 mm. broad, oblanceolate, acute; lateral sepals 5–8 mm. long and together 3–5 mm. broad, ovate or oblong-ovate, connate to their apices, slightly gibbous at the base. Petals 2.2–2.7 mm. long and 1.2–1.5 mm. broad, obovate, acute or obtuse, serrulate above. Lip 2–3 mm. long and 1.2–1.5 mm. broad, oval, obtuse, denticulate above, unguiculate, with 2 small inflexed, crescent-shaped lateral lobes near the middle of the lip and 2 auricles at the base of the claw; lamina with 2 parallel callus-like thickenings near the middle.

Mexico, Guatemala, Honduras, Costa Rica, Panama, and possibly Venezuela.

COCLÉ: hills south of El Valle de Antón, alt. 700 m., *Allen 2513;* between Las Margaritas and El Valle, *Woodson, Allen & Seibert 1282.*

31. PLEUROTHALLIS VELATICAULIS Reichb. f. in Linnaea 22:824. 1849.

Pleurothallis Pittieri Schltr. in Fedde Rep. Sp. Nov. 3:247. 1907.

Small to large, caespitose, epiphytic herbs up to about 6 dm. tall. Secondary stems up to 4 dm. long, slender to stout, partly to entirely covered with loose sheaths. Leaves extremely variable, 8–22 cm. long and 1.2–9 cm. broad, oblanceolate-ligulate to oval, attenuated into a petiole at the base. Inflorescence a raceme or fascicle of racemes, shorter than the leaf. Dorsal sepal 3–5.5 mm. long and 1.2–1.8 mm. broad, lanceolate or lanceolate-oblong, acute, somewhat cucullate. Lateral sepals 3.5–5 mm. long and 1–1.8 mm. broad, lanceolate, acute, lightly connate nearly to the apices but becoming free. Petals 1.5–3 mm. long and 0.5–0.75 mm. broad, oblong to oblong-oblanceolate, obtuse. Lip 1–2 mm. long and 1–1.5 mm. broad, oblong-oval to subrhombic, obtuse, with fleshy, erect, auriculate lateral lobes near the middle.

Costa Rica, Panama, the West Indies, and from Venezuela to Peru.

CHIRIQUÍ: forests between Las Palmas and top of Cerro de la Horqueta, alt. 2100–2268 m., *Pittier 3227.* COCLÉ: hills north of El Valle de Antón, alt. 1000 m., *Allen 2245.*

One of the most variable of the species of *Pleurothallis* in Panama.

32. PLEUROTHALLIS GELIDA Lindl. in Bot. Reg. 27: Misc. p. 91. 1841.

Pleurothallis chiriquensis Schltr. in Fedde Rep. Sp. Nov. Beih. 17:19. 1922.

Caespitose epiphytic herbs up to about 5.5 dm. tall. Secondary stems up to about 3.5 dm. long and about 0.4 cm. in diameter toward the base, partially covered with chartaceous sheaths. Leaves 8–23 cm. long and 1.5–7 cm. broad, elliptic-oblong to oblong-ovate, obtuse or acute, coriaceous, attenuated into a short petiole at the base. Inflorescence 1-several racemes, either shorter, subequal to, or longer than the subtending leaf, few- to many-flowered. Dorsal sepal 5–7.5 mm. long and 2–2.5 mm. broad, oblong-lanceolate, acute, cucullate, puberulent within. Lateral sepals 5–6 mm. long and each 2–2.5 mm. broad, acute, connate to the middle or nearly so, puberulent within. Petals 2.5–3.5 mm. long and 1.5–2.5 mm. broad, oblong-obovate to subrhombic, obtuse or truncate and the apex often dentate or lobulate. Lip 2–2.5 mm. long and 0.9–1.4 mm. broad, dilated from a

Fig. 110. *Pleurothallis gelida*

narrow base into an oblong-cuneate lamina, truncate, with 2 parallel, lamellate calluses near the middle.

Florida, Mexico to Panama, the West Indies, South America.

BOCAS DEL TORO: "Chiriquí," alt. 1200–1500 m., *Powell 227.*

A variable species and one of the most widespread of the genus.

Fig. 111. *Pleurothallis Rowleei*

33. Pleurothallis Rowleei Ames, Sched. Orch. 1:11. 1922; loc. cit. 7: *t. 18.* 1924.

Pleurothallis cucullata Ames, loc. cit. 3:5. 1923; loc. cit. 7: *t. 17.* 1924.

Caespitose or repent epiphytic herbs up to 3.5 dm. tall. Secondary stems up to 25 cm. long, slender, partially covered with one or two sheaths. Leaves 3–13

Fig. 112. *Pleurothallis praegrandis*

cm. long and 1–5.4 cm. broad, elliptic-lanceolate to ovate-lanceolate, acuminate, subcordate at the base. Inflorescence 1 to few slender racemes, shorter or rarely longer than the subtending leaf. Dorsal sepal 6–11 mm. long and 2.5–5.5 mm. broad, lanceolate to ovate-lanceolate, acute or acuminate, cucullate. Lateral sepals 7–10 mm. long and together 2.2–7 mm. broad, elliptic-oval to ovate, acute or obtuse, connate to the apices. Petals 6–8.5 mm. long and 1.2–2.5 mm. broad, subsigmoid-elliptic, denticulate, acute. Lip 2.5–4 mm. long and 1.5–2.5 mm. broad, subsagittate; the basal portion broad and fleshy; the apical portion narrowly triangular.

Costa Rica and Panama.

CHIRIQUÍ: Bajo Chorro, alt. 1810 m., *Davidson*. DARIÉN: Cana-Cuasi trail, alt. 1650 m., *Terry & Terry 156*.

34. PLEUROTHALLIS PRAEGRANDIS Ames, Sched. Orch. 5:17. 1923; loc. cit. 7: *t. 17*. 1924.

Large, caespitose, epiphytic herbs up to about 12 dm. tall. Secondary stems up to about 9 dm. long. Leaf 31.5 cm. long and 20.5 cm. broad, cordate, acuminate. Inflorescence consisting of several racemes which are shorter than the leaf. Dorsal sepal 2.5–3 mm. long and about 1–1.5 mm. broad, elliptic-oblong, acute. Lateral sepals about 3.5 mm. long, connate to their apices, suborbicular, cochleate. Petals about 2 mm. long and about 1 mm. broad, oblong-spatulate, obtuse, the apex fleshy-thickened. Lip about 1 mm. long and 2.5–3 mm. broad, transversely elliptic; disc with a transversely rhombic thickening in the middle.

Panama.

DARIÉN: Cana and vicinity, alt. about 1800 m., *Williams 973*.

Description based on a photograph and a flower of the type, and the original description.

35. PLEUROTHALLIS ELLIPSOPHYLLA L. Wms. in Ann. Missouri Bot. Gard. 29:344. 1942.

Small, repent or caespitose, epiphytic herbs up to about 2 dm. tall. Secondary stems up to 9.5 cm. long, prominently angled when dry, with one or more loose sheaths covering the basal part. Leaves 4–9.5 cm. long and 0.7–2.7 cm. broad, elliptic to elliptic-oblong, acute or obtuse, coriaceous. Inflorescence of 1 to several short, few-flowered racemes, about half as long as the leaves. Dorsal sepal 9–14 mm. long and 1.5–2.5 mm. broad, narrowly lanceolate to elliptic-oblanceolate, acute or acuminate, cucullate, puberulent dorsally. Lateral sepals 10–13 mm. long and together 3–4 mm. broad, connate except at the very tip, the lamina lanceolate, acute or acuminate, pubescent dorsally, gibbous and with a mentum at the base. Petals 5.5–6.5 mm. long and 1.4–2 mm. broad, elliptic or elliptic-lanceolate, acute or acuminate, arcuate, denticulate or denticulate-lacerate toward the middle but the base and apex usually entire. Lip 4–5 mm. long and 1–1.3 mm. broad, lanceolate, acute or subaristate, biauriculate at the base, claw

Fig. 113. *Pleurothallis ellipsophylla*

short; lamina with an inconspicuous V-shaped callus on the basal ⅓.

Panama.

BOCAS DEL TORO: Maccaw Hill, Isla Colón, alt. 0–125 m., *von Wedel 560;* Río Cricamola, between St. Louis and Konkintöe, alt. about 10–15 m., *Woodson, Allen & Seibert 1884.*

36. PLEUROTHALLIS STENOSTACHYA Reichb. f. in Linnaea 18:399. 1844.

Pleurothallis myriantha Lehm. & Kränzl. in Engl. Bot. Jahrb. 26:445. 1899.
Pleurothallis Lankesteri Rolfe in Kew. Bull. 1914: 210. 1914.
Pleurothallis dubia Rich. & Gal. var. *myriantha* Schltr. in Fedde Rep. Sp. Nov. Beih. 17:20. 1922.
Pleurothallis stenostachya Reichb. f. var. *Lankesteri* Ames, Sched. Orch. 7:31, *t. 15 pars.* 1924.

Small, caespitose, epiphytic herbs up to about 1 dm. tall. Secondary stems up to about 2 cm. long, very slender, covered with loose sheaths. Leaves long-petiolate; lamina 0.5–5 cm. long and 0.3–0.9 cm. broad, linear-elliptic to oblong-elliptic or usually oblanceolate, attenuated into the petiole; petiole very slender, 0.3–3 cm. long. Inflorescence a fascicle of short, few-flowered racemes; the flowers from greenish to brick-red and very small. Dorsal sepal 1.2–1.7 mm.

long, lanceolate-ovate to ovate, strongly cucullate, acute. Lateral sepals 1.2–1.5 mm. long and 0.5–0.75 mm. broad, segments lanceolate-ovate, acuminate, connate below the middle. Petals 1–1.5 mm. long and 0.2–0.6 mm. broad, linear-lanceolate, acute, arcuate. Lip 1.1–1.3 mm. long and 0.5–0.7 mm. broad, elliptic-oval, obtuse, glandular-puberulent above, short-unguiculate.

Mexico, British Honduras, Guatemala, Honduras, Costa Rica, and Panama.

CHIRIQUÍ: Boquete, alt. 1500 m., *Davidson 1268;* El Boquete, alt. 1000–1300 m., *Pittier 2989;* "Chiriquí," alt. 1060 m., *Powell 224;* vicinity of Boquete, alt. 1200–1500 m., *Woodson & Schery 800.*

A small-flowered and distinctive species.

37. PLEUROTHALLIS OVATILABIA Ames & Schweinf. Sched. Orch. 10:33. 1930.

Small, caespitose, epiphytic herbs up to about 8 cm. tall. Secondary stems up to about 6 mm. long, covered with scarious sheaths. Leaves 2.5–6 cm. long and 0.25–0.6 cm. broad, narrowly oblanceolate, obtuse, attenuated into a long petiole at the base. Inflorescence surpassing the leaves or rarely subequal; raceme slender, unilateral, up to about 3 cm. long. Sepals 1.5–1.8 mm. long and 0.9–1 mm. broad, subovate or oblong-ovate, acute or obtuse, cucullate. Petals 1.4–1.5 mm. long and 0.3–0.4 mm. broad, linear-lanceolate, acute, falcate. Lip 1.5–2.5 mm. long and about 1 mm. broad, ovate, acute.

Honduras, Costa Rica, and Panama.

CHIRIQUÍ: El Boquete, alt. 1000 m., *Pittier 2990.*

Possibly only a variety of *P. lancilabris* (Reichb. f.) Schltr.

38. PLEUROTHALLIS GROBYI Batem. ex Lindl. in Bot. Reg. 21: *t. 1797.* 1835; Hook. in Bot. Mag. 65: *t. 3682.* 1838; L. Wms. ex A. C. Sm. in Lloydia 2:172. 1939.

Pleurothallis picta Lindl. in Bot. Reg. 21: sub *t. 1797.* 1835; Lindl. loc. cit. 21: *t. 1825.* 1836.
Pleurothallis marginata Lindl. loc. cit. 24:Misc. p. 42. 1838.
Pleurothallis panamensis Schltr. in Fedde Rep. Sp. Nov. 17:140. 1921.
Pleurothallis dryadum Schltr. in Fedde Rep. Sp. Nov. Beih. 19:186. 1923, non Schltr. 1922.
Pleurothallis integrilabia Ames, Hub. & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 3:39. 1934.

Small, densely caespitose, epiphytic herbs up to about 15 cm. tall. Leaves 1.5–7 cm. long and 0.15–0.8 cm. broad, ob-

Fig. 114. *Pleurothallis Grobyi*

lanceolate to ovate-lanceolate to suborbicular, obtuse or acute, often marginate, attenuated into a petiole at the base. Inflorescence a few- to several-flowered raceme, usually much exceeding the leaf. Dorsal sepal 3.2–9 mm. long and 1.2–3 mm. broad, lanceolate to elliptic-ovate, acute or acuminate, cucullate. Lateral sepals 3–11 mm. long and together 1.2–3 mm. broad, lanceolate to oblong-lanceolate to ovate-lanceolate, acute or acuminate, gibbous at the base, connate to the apex or nearly so. Petals 1.5–2.5 mm. long and 0.4–0.8 mm. broad, ovate-oblanceolate or nearly so, acute or obtuse, more or less oblique. Lip 2–3 mm. long and 0.6–1.3 mm. broad, oblong, obtuse, short-unguiculate.

Mexico to Panama, the West Indies and in South America.

CANAL ZONE: Quebrada Lopez, *Allen 2137*; Barro Colorado Island, *Aviles 55*; *Shattuck 226, 546*; *Standley 31499, 41176*; near Vigia and San Juan, alt. 66 m., *Dodge, Steyermark & Allen 16526*; around Gamboa, alt. 2–100 m., *Pittier 4787*; hills north of Frijoles, *Standley 27665*; Salamanca Hydrographic Station, alt. about 80 m., *Woodson, Allen & Seibert 1560, 1580*. CHIRIQUÍ and VERAGUAS: auf Pampasbäumen, *Wagner 24*. COLÓN: Río Indio, alt. near sea-level, *Pittier 4264*. PANAMÁ: Río La Maestra, alt. 0–25 m., *Allen 53*; hills east of Panama City, *Powell 106*.

Pleurothallis Grobyi is quite a variable and widespread species. It is found mostly near sea-level, rarely as high as 900 meters.

39. PLEUROTHALLIS CALYPTROSTELE Schltr. in Fedde Rep. Sp. Nov. Beih. 19:23. 1923; L. Wms. in Ann. Missouri Bot. Gard. 27:276, *t. 33, figs. 11-15*. 1940.

Pleurothallis biflora Schltr. loc. cit. 181, non Focke.
Pleurothallis geminiflora Ames, Hub. & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 3:39. 1934.

Fig. 115. *Pleurothallis calyptrostele*

Small, repent or caespitose, epiphytic herbs up to about 3 cm. tall. Secondary stems about 2–3 mm. long, covered with scarious sheaths. Leaves 5–15 mm. long

and 1–4 mm. broad, oblanceolate, obtuse, attenuated into a petiole at the base. Inflorescence a few-flowered raceme, longer than the leaves. Dorsal sepal 4–5.5 mm. long and 1.2–1.5 mm. broad, oblong-lanceolate, acuminate. Lateral sepals 3.5–6 mm. long and 1–1.6 mm. broad, lanceolate, acuminate, arcuate, free nearly to the bases. Petals 1.8–2 mm. long and 0.5–0.6 mm. broad, oblanceolate, acute, slightly oblique. Lip 2–2.5 mm. long and 0.5–1 mm. broad, narrowly oblong, obtuse.

Costa Rica and Panama.

COCLÉ: vicinity of El Valle, alt. 600–1000 m., *Allen 1233*.

40. PLEUROTHALLIS FUEGII var. **echinata** L. Wms., var. nov.[1]

Small, caespitose, epiphytic herbs up to about 4 cm. tall. Secondary stems very short, up to about 3 mm. long, covered with loose sheaths. Leaves 10–17 mm. long and 3–6 mm. broad, oval to oblong-obovate, obtuse, attenuated into a slender petiole at the base. Inflorescence exceeding the leaves, a simple few-flowered raceme. Dorsal sepal 8–9 mm. long and 1.5–2 mm. broad, lanceolate, long-acuminate. Lateral sepals connate to about the middle, about 7–9 mm. long and together about 3 mm. broad, the segments lanceolate, long-acuminate. Petals 2.5–3 mm. long and 0.6–1 mm. broad, oblong-lanceolate, obtuse. Lip about 3.5 mm. long and about 1.5 mm. broad, short-unguiculate, oblong-ovate, obtuse, constricted toward the middle. Ovary echinate.

Endemic in Panama.

CHIRIQUÍ: Volcán de Chiriquí, alt. about 2720 m., *Davidson 981* (TYPE in Herb. Ames).

The variety *echinata* differs from the species in having an echinate ovary, narrower petals, larger flowers, and larger leaves. The material is not as good as might be desired, and more adequate material may show it to be a distinct species.

41. PLEUROTHALLIS ARISTATA Hook. in Ann. & Mag. Nat. Hist. 2:329, *t. 15*. 1839.

Pleurothallis dichotoma Ames, Sched. Orch. 6:58. 1923, non Schltr.
Pleurothallis divexa Ames, loc. cit. 7:20, *t. 5*. 1924.

Small, caespitose, epiphytic herbs up to about 7 cm. tall. Secondary stems very short, 1–3 mm. long. Leaves 8–24 mm. long and 1.5–4.5 mm. broad, oblong to oblanceolate, obtuse, attenuated into a petiole at the base. Inflorescence much exceeding the leaves, a fractiflex raceme with relatively few flowers. Dorsal sepal 4.5–9 mm. long and 1–1.8 mm. broad, lanceolate to ovate-lanceolate, aristate-acuminate, cucullate. Lateral sepals 4.5–9 mm. long and 1–1.6 mm. broad, lanceolate, aristate-acuminate, connate about 1 mm. at the base. Petals about 2–3 mm. long and 1–1.5 mm. broad, lanceolate-ovate to ovate, acute or acuminate, fimbriate or lacerate-fimbriate. Lip 2–3 mm. long and 0.6–1.5 mm. broad, ob-

[1]Herbae parvae caespitosae epiphyticae usque ad 4 cm. altae. Folia ovalia vel oblongo-ovata, obtusa. Sepalum dorsale lanceolatum, acuminatum. Sepala lateralia usque ad medium connata, lanceolata, acuminata. Petala oblongo-oblanceolata, obtusa. Labellum oblongo-ovatum, obtusum. Ovarium echinatum.

long, obtuse, subauriculate at the base, with 2 erect side lobes, keeled on the mid-nerve below, apical half of lip more or less fleshy and terete, lepidote-verrucose.

Costa Rica, Panama, and the West Indies.

CHIRIQUÍ: Bajo Chorro, alt. 1800 m., *Davidson 187*.

The specimen upon which this record is based is unsatisfactory but perhaps it belongs to this species.

42. PLEUROTHALIS PRUINOSA Lindl. in Bot. Reg. 28: Misc. p. 75. 1842.

Pleurothallis pauciflora Schltr. in Fedde Rep. Sp. Nov. Beih. 19:192. 1923.

Small, caespitose or repent, epiphytic herbs up to about 14 cm. tall. Secondary stems slender, usually with but one sheath, longer than the leaves. Leaves 1–5 cm. long and 0.4–0.7 cm. broad, linear-elliptic to linear-lanceolate (rarely broader), acute or obtuse, coriaceous. Inflorescence a slender, few-flowered raceme, subequal to or exceeding the leaves (rarely shorter). Dorsal sepal 2.5–4 mm. long and 1.5–1.8 mm. broad, lanceolate to ovate-lanceolate, acute or acuminate, cucullate. Lateral sepals 2.5–4 mm. long and together 1.5–2.5 mm. broad, ovate or ovate-lanceolate, cochleate, connate to their apices. Petals 2–3 mm. long and 0.3–0.5 mm. broad, linear or linear-lanceolate, acute. Lip 1.5–2 mm. long and 0.8–1 mm. broad, ovate-lanceolate to triangular-lanceolate, acute or acuminate, fleshy.

Honduras, Costa Rica, Panama, the West Indies, Surinam, French Guiana, and possibly Peru.

CHIRIQUÍ: Boquete, alt. 1150 m., *Davidson 708;* Chiriquí, alt. 1200 m., *Powell 434*.

A variable species. The Central American material is usually smaller than that from the West Indies.

43. PLEUROTHALLIS MACRANTHA L. Wms. in Ann. Missouri Bot. Gard. 28:417, *pl. 21, figs. 1-6*. 1941.

Caespitose, epiphytic or terrestrial herbs up to 23 cm. tall. Secondary stems 6–8 cm. long, subequal to the leaves in length on mature plants, almost completely invested with one or two loose, scarious sheaths, unifoliate. Leaves 4–7 cm. long and 1.5–2.8 cm. broad, elliptic, obtuse, coriaceous. Inflorescence a several-flowered raceme, about twice exceeding the subtending leaves; sheath at the base of the peduncle short, about 9–11 mm. long; bracts 6–7 mm. long, ovate-lanceolate, scarious, semiamplexicaul. Dorsal sepal 16–20 mm. long and 6–8 mm. broad, elliptic to oblanceolate-elliptic, acute, 3-nerved, keeled dorsally along the mid-nerve. Lateral sepals 16–18 mm. long and together 6–8 mm. broad, connate almost to their apices, oblong-oblanceolate, acute, together 4-nerved, somewhat gibbous at the base. Petals about 9–11 mm. long and 5–6 mm. broad near the apex, oblong-obovate, slightly oblique, truncate or slightly retuse, 3-nerved, with an inconspicuous cushion-like callus near the base. Lip 10–12 mm. long and 3–4 mm. broad toward the apex when expanded, about 2 mm. broad near the middle and 3 mm. broad across the auriculate base, subterete, and sulcate above, somewhat

laterally compressed, expanding toward the apex and into two auricles at the base, with three small calluses between the basal auricles.

Endemic in Panama.

CHIRIQUÍ: Bajo Chorro, alt. 1900 m., *Woodson & Schery 666.*

A very large-flowered species of *Pleurothallis.*

44. PLEUROTHALLIS TUERCKHEIMII Schltr. in Fedde Rep. Sp. Nov. 10:292. 1912.
Pleurothallis megachlamys Schltr. in Fedde Rep. Sp. Nov. Beih. 19:108. 1923.

Caespitose epiphytic herbs up to about 7.5 dm. tall, but usually about 3 dm. tall. Secondary stems 5.5–42 cm. long, usually provided with 1–2 loose, ancipitous, brown, chartaceous sheaths. Leaves 8–27 cm. long and 2.5–7.5 cm. broad, elliptic to oval, obtuse or rarely acute, attenuated into a short petiole at the base, either longer or shorter than the secondary stem, usually shorter than the inflorescence or occasionally subequal. Inflorescence an erect raceme which usually exceeds the leaves, the flowers among the largest of the genus; sheath up to about 9 cm. long, conspicuous. Dorsal sepal 11–25 mm. long and 4–6 mm. broad, lanceolate, acute or acuminate, cucullate, puberulent dorsally. Lateral sepals connate nearly to their apices, 14–25 mm. long and 6–7 mm. broad, elliptic to oblong-lanceolate, acute, puberulent dorsally. Petals 4.5–8 mm. long and 2.5–4 mm. broad, oblong-oval to oval, arcuate, verrucose and subcochleate toward the apex. Lip 5–9 mm. long and about 3–3.5 mm. broad, auriculate at the base, the auricles erect; lamina ligulate, rostrate, fleshy, smooth or verrucose.

Mexico, Guatemala, Costa Rica, and Panama.

CHIRIQUÍ: upper Río Chiriquí Viejo, alt. 1300–1900 m., *White & White 18;* vicinity of Monte Lirio, alt. 1300–1900 m., *Seibert 142.*

45. PLEUROTHALLIS POWELLII Schltr. in Fedde Rep. Sp. Nov. Beih. 17:22. 1923.

Large (for genus), caespitose, epiphytic herbs up to about 7 dm. tall. Secondary stems up to probably 35 cm. long. Leaves 20–25 cm. long and 7–9 cm. broad, oblong-elliptic to ovate-lanceolate, obtuse or acute. Inflorescence several- to many-flowered, exceeding the leaves in length. Sepals all slightly connate at the base, the laterals connate nearly to their apices; dorsal sepal 12–20 mm. long and 2–2.5 mm. broad, ligulate or lanceolate, acute or acuminate; lateral sepals 14–20 mm. long and 6–7 mm. broad, oblong-lanceolate to lanceolate-ovate, cymbiform, acute. Petals about 6 mm. long and 1.6–2.6 mm. broad, oblanceolate to oblong-oblanceolate, obtuse, falcate. Lip about 5 mm. long and 2–2.5 mm. broad, lanceolate-ovate, obtuse, very fleshy, with 2 upright carinate wings above, one on either side and one dorsally.

Costa Rica (?), and Panama.

CHIRIQUÍ: "Chiriquí," alt. 1100–1200 m., *Powell 146, 3365.*

One of the largest species of *Pleurothallis* in Panama. Known only from one collection, with field number and garden number—a numbering often practiced by Mr. Powell, whose field numbers were rarely used on specimens and then always in conjunction with the garden numbers.

46. PLEUROTHALLIS SEGOVIENSIS Reichb. f. in Bonplandia 3:223. 1855; C. Schweinf. in Bot. Mus. Leafl. Harv. Univ. 4:96. 1937.

Pleurothallis Wagneri Schltr. in Fedde Rep. Sp. Nov. 17:141. 1921.
Pleurothallis falcatiloba Ames in Proc. Biol. Soc. Wash. 34:152. 1921.
Pleurothallis canae Ames, Sched. Orch. 2:18. 1923; loc. cit. 7: *t. 13.* 1924.

Caespitose epiphytic herbs 3–22 cm. tall, ordinarily 10–15 cm. tall. Secondary stems about 0.5–6 cm. long, covered with sheaths, much shorter than the leaves. Leaves (when mature) 4.5–12 cm. long and 0.2–1.2 cm. broad, linear-oblanceolate to oblanceolate, obtuse or rarely acutish, gradually attenuated to the base. Inflorescence a few- to several-flowered raceme, often unilateral, usually exceeding the leaves but rarely shorter. Dorsal sepal 5–11 mm. long and 2–3.5 mm. broad, lanceolate to oblong-lanceolate, acute or acuminate, cucullate, keeled dorsally, pubescent within (especially laterally) to glabrous. Lateral sepals 5.5–11 mm. long, oblong-lanceolate to suborbicular-ovate, acute, cucullate to cochleate, connate almost to their apices or rarely connate only ⅔ their length, pubescent within (especially laterally) to glabrous, keeled dorsally along the mid-ribs. Petals 2–3.5 mm. long and 1–1.5 mm. broad, elliptic-lanceolate to ovate, obtuse or acute, more or less arcuate, apex rarely trilobulate, the base auriculate. Lip 3–4 mm. long and 2.5–3 mm. broad, occasionally papilliferous, 3-lobed; lateral lobes basal or subbasal, from lanceolate-falcate to subtriangular, usually erect; lamina oblong, obtuse, with 2 large lamellate or ridge-like calluses on the basal half or two thirds, and with an elongate bipartite central callus at the base.

Mexico, Guatemala, Costa Rica, and Panama.

CHIRIQUÍ: Bajo Chorro, alt. 1800 m., *Davidson 170;* Río Quebrada, alt. 1700 m., *Killip 3540;* "Chiriquí," alt. 1200–1650 m., *Powell 236, 278, 289, 3176; Wagner 25;* Monte Lirio, alt. 1300–1900 m., *Seibert 199, 212, 213, 271;* Bajo Mona, alt. 1500–2000 m., *Woodson, Allen & Seibert 1004.* COCLÉ: vicinity of La Mesa, alt. 1000 m., *Allen 2307.* DARIÉN: Cana and vicinity, *Williams 971.*

One of the most variable of the species of *Pleurothallis* in Panama. The description is taken from all of the specimens available. A critical study may show some of the forms to be varietally distinct. In addition to the Panamanian synonyms listed above the following names seem to belong here also: *Pleurothallis Aguilarii* Ames, *P. amethystina* Ames, *P. Johannis* Schltr., *P. melicoides* Schltr., *P. pompalis* Ames, and *P. vinacea* Ames.

47. PLEUROTHALLIS GHIESBREGHTIANA Rich. & Gal. in Ann. Sci. Nat. III, 3:16. 1845.

Pleurothallis racemiflora Lindl. ex Lodd. Bot. Cab. 10: *t. 949.* 1824, non (Sw.) Lindl. 1824.
Pleurothallis longissima Lindl. Folia Orch. Pleuroth. p. 31. 1859; Reichb. f. in Xenia Orch. 2:114, *t. 137, figs. 6-9.* 1867; in Saunders' Ref. Bot. 2: *t. 141.* 1882.
Pleurothallis lyroglossa Schltr. in Fedde Rep. Sp. Nov. 8:566. 1910.
Pleurothallis Niederleinii Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:396. 1918.

Caespitose or repent epiphytic herbs up to about 6 dm. tall, but usually about 3 dm. tall. Secondary stems 3–18 cm. long, usually shorter than the leaves.

Leaves 4–17 cm. long and 0.9–3 cm. broad, oblanceolate to elliptic-oblong, obtuse or rarely acute, usually attenuated into a short petiole at the base. Inflorescence a few- to usually many-flowered raceme, usually much exceeding the subtending leaves. Dorsal sepal 6–8.5 mm. long and 2.5–4 mm. broad, lanceolate to elliptic-ovate, acute. Lateral sepals 6–8.5 mm. long and together 3–5 mm. broad, elliptic-oblong to oval, acute or obtuse, connate to their apices or nearly so, cucullate. Petals 6–8.5 mm. long and 1.5–3 mm. broad, elliptic-lanceolate to ovate-lanceolate, acute or obtuse, oblique. Lip 3.5–6.5 mm. long and 1.5–3 mm. broad, oblong-pandurate, obtuse, basal portion orbicular, terminal portion oval.

Mexico, British Honduras, Guatemala, Honduras, Costa Rica, Panama, and the West Indies.

CHIRIQUÍ: Cerro Vaca, alt. 900–1136 m., *Pittier 5320*. PANAMÁ: Río La Maestra, alt. 0–25 m., *Allen 63*. VERAGUAS: Bahia Honda, *Taylor 1511*.

48. PLEUROTHALLIS DOLICHOPUS Schltr. in Fedde Rep. Sp. Nov. 10:394. 1912.

Pleurothallis lamprophylla Schltr. loc. cit. 15:205. 1918.
Pleurothallis poasensis Ames, Sched. Orch. 1:10. 1922; loc. cit. 7: *t. 12*. 1924.
Pleurothallis peregrina Ames, loc. cit. 6:67. 1923.

Caespitose or repent epiphytic herbs up to about 3.5 dm. tall. Secondary stems up to about 23 cm. long, usually exceeding the leaves. Leaves 5–15 cm. long and 1.3–3.5 cm. broad, elliptic-oblong, obtuse or rarely acute, contracted into a short petiole at the base. Inflorescence 1 or more, few- to many-flowered racemes, subequal to or usually exceeding the leaves. Dorsal sepal 14–23 mm. long and 2–3.5 mm. broad, linear-lanceolate to lanceolate, ciliate and puberulent to glabrous within. Lateral sepals 9–22 mm. long and 1.5–3 mm. broad, linear-lanceolate to lanceolate, acuminate, ciliate and puberulent to glabrous within, free almost to their bases. Petals 3–5 mm. long and 1–2 mm. broad, from nearly oblong to oblong-oblanceolate, obtuse. Lip 2.5–5 mm. long and 0.8–2.5 mm. broad, oblong to oblong-obovate, obtuse, the disc with 3 longitudinal calluses and the outer 2 serrated in front but erect and forming the side of the lip below, terminal part of the lip denticulate or entire.

Mexico, Guatemala, Costa Rica, and Panama.

CHIRIQUÍ: Volcán de Chiriquí, alt. 2875 m., *Davidson 1030;* Volcán de Chiriquí, alt. 3500–4000 m., *Woodson & Schery 392*.

Some Mexican specimens have the sepals no more than 6 mm. long, which is unusual. The normal length is about 12 mm.

49. PLEUROTHALLIS PFAVII Reichb. f. in Flora 69:555. 1886.

Masdevallia platyrachis Rolfe in Gard. Chron. III, 4:178. 1888.
Pleurothallis platyrachis Rolfe in Jour. Bot. 28:136. 1890; Hook. f. in Bot. Mag. 116: *t. 7129*. 1890.
Kraenzlinella platyrachis Rolfe in Orch. Rev. 23:326. 1915.

Caespitose epiphytic herbs up to about 30 cm. tall. Secondary stems up to about 2 cm. long. Leaves 7–20 cm. long and 1.2–3 cm. broad, ligulate-oblanceolate, obtuse, coriaceous, attenuated into a petiole at the base. Inflorescence up to

25 cm. long, exceeding the leaves; peduncle ancipitous and winged, with one or more bracts; rachis fractiflex, somewhat flattened or nearly terete, bracts large. Sepals spreading, free nearly to their bases, verrucose within except at the bases, keeled dorsally toward their apices. Dorsal sepal 13–20 mm. long and 4.5–5.5 mm. broad, lanceolate to ovate-lanceolate, acute, cucullate. Lateral sepals 13–20 mm. long and 2–4 mm. broad, lanceolate, acute, connate nearly to their apices. Petals 4–5 mm. long and about 1 mm. broad, ligulate, falcate, verrucose externally. Lip 5–6 mm. long and about 1.5 mm. broad, lanceolate, arcuate, acute, with a pair of inframarginal, lamellate calluses beginning above the base and extending nearly to the apex.

Mexico, Costa Rica, and Panama.

CHIRIQUÍ: "Chiriquí," *Pfau.*

Originally collected in Panama but not reported in recent years.

50. PLEUROTHALLIS SPECTABILIS Ames & Schweinf. Sched. Orch. 8:34. 1925.

Caespitose epiphytic herbs up to about 3 dm. tall. Secondary stems up to 1.5 cm. long, covered with loose, tubular sheaths. Leaves 6–13 cm. long and 0.6–1.5 cm. broad, elliptic-oblanceolate to oblanceolate, obtuse or acute, attenuated into a petiole at the base. Inflorescence up to 30 cm. long, much overtopping the leaves; peduncle ancipitous; rachis distichous. Sepals spreading, lanceolate, acute, densely verrucose within except at the bases. Dorsal sepal 15–21 mm. long and 5.5–7.5 mm. broad, cucullate toward the base. Lateral sepals 15–21 mm. long and 4–5.5 mm. broad, arcuate, connate at the base. Petals 3–5 mm. long and 1–1.5 mm. broad, oblong-falcate, slightly broader toward the obtuse or tridentate thickened apex, slightly verrucose. Lip 4.5–6 mm. long and about 2 mm. broad, oblong, obtuse or slightly retuse, base of lip thin, upper ⅔ somewhat fleshy and with a pair of inframarginal, lamellate calluses which extend nearly to the apex.

Costa Rica and Panama.

VERAGUAS: Santa Fé, alt. 460 m., *Powell 382.*

51. PLEUROTHALLIS MURICATA Schltr. in Fedde Rep. Sp. Nov. 10:293. 1912.

Pleurothallis sororoa Schltr. loc. cit. 294.
Pleurothallis diuturna Schltr. in Fedde Rep. Sp. Nov. Beih. 17:19. 1922; Ames, Sched. Orch. 7: *t. 19.* 1924.

Caespitose or repent, epiphytic herbs up to about 5 dm. tall. Secondary stems up to 5.5 cm. long, usually angled and sulcate. Leaves 8–17 cm. long and 1.2–4 cm. broad, oblong-ligulate, obtuse, coriaceous, somewhat attenuated to the base. Inflorescence up to 23 cm. long, peduncle and rachis terete, the rachis somewhat fractiflex and distichous, much exceeding the leaves. Sepals free nearly to their bases, fleshy, keeled along the mid-nerve dorsally. Dorsal sepal 6–18 mm. long and 4–7 mm. broad, broadly lanceolate, acute, cucullate. Lateral sepals 13–19 mm. long and 3–5.5 mm. broad, lanceolate, acute, cucullate. Petals 5–10 mm. long and 1.2–2.5 mm. broad, linear-elliptic to elliptic-oblanceolate, acute, slightly arcuate, obscurely auriculate at the base, adnate to the base of the column. Lip

6–10 mm. long and 2–3.2 mm. broad, unguiculate, ligulate, lobulate toward the base; the claw short, thin; lamina fleshy, the surface slightly muricate, arcuate, with two small, erect, lateral lobes toward the base. Ovary muricate.

Mexico to Panama, possibly Peru.

COCLÉ: vicinity of El Valle de Antón, alt. 800 m., *Allen 2294, Hunter & Allen 361.*
VERAGUAS: near Santiago, alt. 150–220 m., *Powell 172.*

52. PLEUROTHALLIS CRENATA Lindl. in Gard. Chron. 6:207. 1846; Lindl. Folia Orch. Pleuroth. p. 38. 1859.

Masdevallia aperta Kränzl. in Fedde Rep. Sp. Nov. 17:430. 1921.
Pleurothallis Hunteriana Schltr. in Fedde Rep. Sp. Nov. Beih. 17:20. 1922.
Pleurothallis hamata Rolfe ex Ames, Sched. Orch. 3:8. 1923.
Pleurothallis aperta Ames, Sched. Orch. 7:17, *fig. 3.* 1924.

Small repent or caespitose herbs up to about 15 cm. tall. Secondary stems up to 1 cm. long. Leaves 4.5–13 cm. long and 1–2.7 cm. broad, broadly to narrowly oblanceolate, acute or obtuse, attenuated into a petiole at the base. Inflorescence about half as long as the leaves, 1- to several-flowered, peduncle and rachis terete. Sepals more or less spreading, minutely papilliferous within, keeled or winged along the mid-nerve dorsally, the keel or wing extending onto the ovary, the apices subterete; dorsal sepal 11–18 mm. long and about 3–3.5 mm. broad, lanceolate, cucullate; lateral sepals 12–18 mm. long and 1.5–3 mm. broad, lanceolate, acute, connate to, or nearly to, the middle. Petals 4–4.5 mm. long and 1.5–2 mm. broad, oblong-lanceolate, somewhat pandurate, acute, slightly oblique. Lip 4.5–5 mm. long and 1.5–2 mm. broad, oblong-lanceolate, obtuse or acutish, the sides erect and fleshy, disc densely papillose-verrucose.

Mexico, Costa Rica, and Panama.

CHIRIQUÍ: without locality, alt. 1200–1500 m., *Powell 245, 277, 3436.*

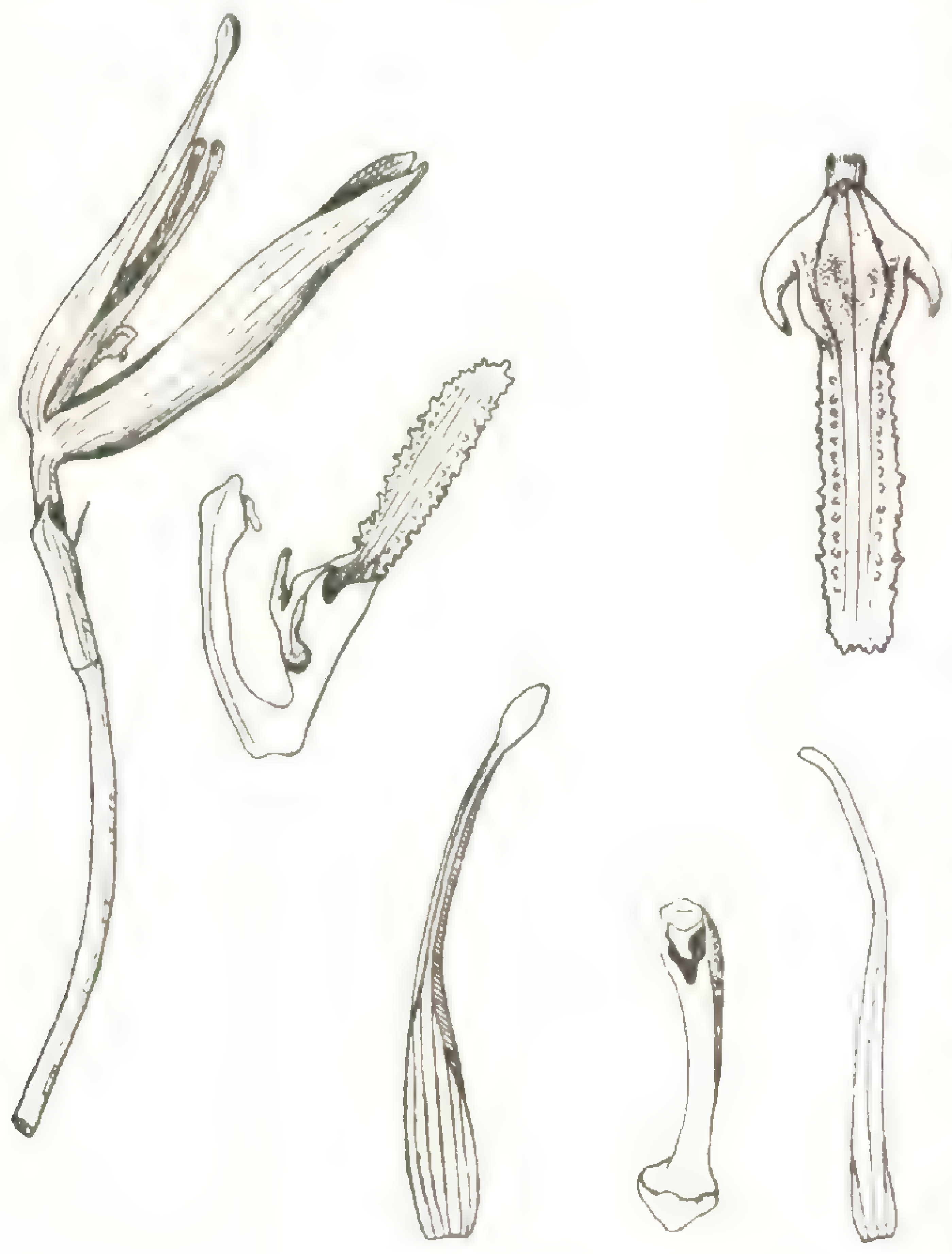


Fig. 116. *Pleurothallis filamentosa*

53. PLEUROTHALLIS FILAMENTOSA (A. & S.) L. Wms. in Bot. Mus. Leafl. Harv. Univ. 8:144. 1940.

Restrepia filamentosa Ames & Schweinf. Sched. Orch. 8:19, *fig. 3.* 1925.

Small, caespitose, epiphytic herbs up to 12 cm. tall. Secondary stems up to about 6.5 cm. long, slender, covered with loose, chartaceous sheaths. Leaves 4–5.5 cm. long and 1–1.7 cm. broad, elliptic or elliptic-lanceolate, acute, attenuated into a short petiole at the base. Inflorescence shorter than the leaves; peduncle

slender, 1-flowered, pedicel with a short filamentose appendage on the anterior side. Dorsal sepal 13–16 mm. long and about 2 mm. broad, linear-lanceolate, the terminal half subfiliform and the apex thickened and clavate, free nearly to the base. Lateral sepals 14–16 mm. long and together 4–5 mm. broad, connate nearly to their apices, puberulent within, the lamina oblong-lanceolate, the free apices acute. Petals 10–12 mm. long, about 0.5 mm. broad, subfiliform, apices thickened and clavate. Lip about 6–7 mm. long and 2–2.5 mm. broad, 3-lobed, lanceolate-ligulate, obtuse, short-unguiculate; the basal ⅓ oval, fleshy, with a small porrect lobe near the middle on either side; terminal ⅔ linear-oblong, denticulate, the surface more or less verrucose.

Panama.

CHIRIQUÍ: Cerro Horqueta, alt. 1500–1700 m., *Powell 344.*

Very closely allied to *P. subserrata* (Schltr.) L. Wms.

54. PLEUROTHALLIS SUBSERRATA (Schltr.) L. Wms. in Bot. Mus. Leafl. Harv. Univ. 8:144. 1940.

Restrepia subserrata Schltr. in Fedde Rep. Sp. Nov. Beih. 19:291. 1923.

Small, caespitose, epiphytic herbs up to about 15 cm. tall. Secondary stems up to about 9 cm. long, covered with loose, chartaceous sheaths which disentegrate with age. Leaves 4–6 cm. long and 1.5–3 cm. broad, elliptic to ovate, obtuse, contracted into a short petiole at the base. Inflorescence as long as or exceeding the leaves; peduncle 1 or more from each stem, slender, 1-flowered. Dorsal sepal 1.6–2 cm. long and about 0.2 cm. broad, narrowly lanceolate, with the terminal half subfiliform and the apex clavellate, free nearly to the base. Lateral sepals 1.6–2 cm. long and together 0.5–0.65 cm. broad, connate nearly to their apices; the lamina oblong-elliptic, the apices acute. Petals about 1.3 cm. long, 0.75 cm. broad at the base, with a narrow, entire or denticulate lamina at the base, but the remainder subfiliform and the apex clavellate. Lip 8–10 mm. long and 2–3 mm. broad at the base, lanceolate-ligulate, acute or obtuse, short-unguiculate; the basal ⅓ oval, fleshy, with a small porrect lobe on either side near the middle; terminal ⅔ linear-oblong, serrulate, the surface slightly verrucose.

Costa Rica and Panama.

CHIRIQUÍ: vicinity of "New Switzerland," central valley of Río Chiriquí Viejo, alt. 1800–2000 m., *Allen 1384;* Bajo Chorro, alt. 2000 m., *Davidson 116.*

55. PLEUROTHALLIS XANTHOPHTHALMA (Reichb. f.) L. Wms. in Bot. Mus. Leafl. Harv. Univ. 8:144. 1940.

Restrepia xanthophthalma Reichb. f. in Hamb. Gartenzeit. 21:300. 1865.
Restrepia Lansbergii "Reichb. f.", sensu Hook. in Bot. Mag. 87: *t. 5257.* 1861.
Restrepia Powellii Schltr. in Fedde Rep. Sp. Nov. Beih. 17:25. 1922.
Restrepia Tonduzii Schltr. loc. cit. 19:291. 1923.

Caespitose epiphytic herbs up to 2 dm. tall. Secondary stems up to about 12 cm. long, slender, covered with several loose, ancipitous sheaths. Leaves 3.5–8

cm. long and 0.6–3.5 cm. broad, elliptic to lanceolate to ovate, acute or obtuse, attenuated into a short petiole at the base. Inflorescence 1- to several-flowered, very much shorter than the leaves, rarely reaching to the middle of the subtending leaf. Dorsal sepal 10–12 mm. long and 1–2 mm. broad, linear-lanceolate, becoming subfiliform above, with the apex clavellate. Lateral sepals 8–12 mm. long, together 4–6 mm. broad, connate nearly to their apices, the lamina oval to obovate. Lip 5–6.5 mm. long and 2–2.5 mm. broad, ovate-lanceolate, obtuse, with two slender lateral lobes near the base, terminal part somewhat narrowed and ciliate or denticulate.

Mexico, Guatemala, Honduras, Costa Rica, and Panama.

CHIRIQUÍ: "Chiriquí," alt. 1280 m., *Powell 123*.

EXCLUDED OR OBSCURE SPECIES

PLEUROTHALLIS BARBAE Schltr. in Fedde Rep. Sp. Nov. Beih. 19:104. 1923.

Specimens so determined belong elsewhere.

PLEUROTHALLIS PERPUSILLA Reichb. f. in Bot. Voy. Herald, 215. 1852.

Obscure, possibly a species of *Stelis*.

PLEUROTHALIS PHYLLOCARDIA Reichb. f. Beitr. Orch. Centr.-Am. 97. 1866.

The species is obscure. Specimens so determined belong elsewhere.

PLEUROTHALLIS PHYLLOCARDIOIDES Schltr. in Fedde Rep. Sp. Nov. Beih. 19:193. 1923.

A plant so determined, from Darién Province, is probably an undescribed species but the material is not good.

PLEUROTHALLIS PYROSODES Reichb. f. in Gard. Chron. n. s. 6:386. 1876; Schltr. loc. cit. 17:22. 1922.

The specimen reported by Schlechter is *P. Brighamii* S. Wats.

24. MALAXIS Solander ex Swartz

MALAXIS Solander ex Sw. Nov. Gen. & Sp. Pl. Prodr. 119. 1788; in Svenska Vet.-Akad. Handl. 21:233. 1800; Fawc. & Rendle, Fl. Jam. 1:41. 1910.

Achroanthes Raf. in Med. Repos. N. Y. 5:352. 1808.
Microstylis Nutt. Gen. N. Am. Pl. 2:196. 1818; Lindl. Gen. & Sp. Orch. Pl. 18. 1830; Benth. & Hook. Gen. Pl. 2:494. 1883; Pfitzer in Engler & Prantl. Nat. Pflanzenf. II, 6:130. 1888; Ridley in Jour. Linn. Soc. 24:308-351. 1888.

Small, erect or repent, terrestrial or epiphytic herbs with cormous pseudobulbs or repent stems. Section EUMALAXIS with cormous, usually hypogaeous, pseudobulbs bearing 1 or 2 leaves. Section BLEPHARIGLOTTIS with more or less elongated stems and leaves scattered along them. Leaves 1–3, continued at the base into a sheathing petiole, membranaceous, the lamina usually broad. Scape or peduncle slender, usually elongated. Inflorescence a spicate or subumbellate raceme; flowers small. Sepals free or the laterals connate, subequal, spreading. Petals equal to the sepals or usually shorter, narrow to subfiliform. Lip erect or spreading, sessile, entire or lobed, usually cordate or auriculate, with the auricles embracing the column, usually broader than the sepals, concave at the base (or plane in

Malaxis Wendlandii). Column very short, terete, usually at right angles to the axis of the lip; anther erect or suberect, persistent, 2-celled, the cells often nearly separate; pollinia 4, 2 in each cell of the anther, waxy, their long axis parallel to the long axis of the column or nearly so; caudicle none.

About 200 species distributed in the temperate and tropical regions with the greatest concentration in tropical Asia and Oceania.—A fascinating but difficult genus, closely allied to *Liparis*, and with no really good characters separating the two. The section BELPHARIGLOTTIS is entirely tropical American, and while it resembles some species of *Liparis* its characters are more those of *Malaxis*.

a. Plants with short, slender, leafy stems.
  b. Lip 5.5–9.5 mm. long; petals 4.5–7 mm. long.......... 10. M. TIPULOIDES
  bb. Lip 3–4 mm. long; petals 3–3.5 mm. long.......... 9. M. BLEPHARIGLOTTIS
aa. Plants with short bulbous stems which are not leafy along their length but bear 1 or 2 leaves.
  b. Leaf 1; inflorescence a narrow raceme or spike.
    c. Lip simple in front, not tridentate, trilobate, nor retuse.......... 1. M. MAJANTHEMIFOLIA
    cc. Lip not simple in front, either tridentate, trilobate, or retuse.
      d. Lip obovate-triangular; anther rostrate.......... 11. M. WENDLANDII
      dd. Lip not obovate-triangular; anther not rostrate.
        e. Lip tridentate at the apex; inflorescence a dense spike.......... 3. M. SOULEI
        ee. Lip trilobate in front; inflorescence a sublax raceme.......... 2. M. PITTIERI
  bb. Leaves 2; inflorescence a subumbellate raceme.
    c. Lip ciliate or denticulate.......... 8a. M. PARTHONII var. DENTICULATA
    cc. Lip neither ciliate nor denticulate.
      d. Lip tridentate or trilobate near the apex.
        e. Lip subquadrate in outline, with linear-lanceolate basal auricles.......... 6. M. WOODSONII
        ee. Lip not subquadrate in outline, without linear-lanceolate auricles.
          f. Lip without basal auricles.......... 4. M. SIMILLIMA
          ff. Lip with erect or uncinate basal auricles.......... 5. M. EXCAVATA
      dd. Lip entire in front.
        e. Lip suborbicular to transversely oblong-oval, 3.5–7 mm. broad.......... 8. M. PARTHONII
        ee. Lip ovate-triangular to ovate-lanceolate; 1.5–2.5 mm. broad.... 7. M. FASTIGIATA

1. MALAXIS MAJANTHEMIFOLIA Cham. & Schlecht. in Linnaea 6:59. 1831; Ames & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 3:121. 1935; L. Wms. in Ann. Missouri Bot. Gard. 26:281. 1939.

Malaxis ichthiorhynca Rich. & Gal. in Ann. Sci. Nat. III, 3:18. 1845.
Malaxis cochleariaefolia Rich. & Gal. loc. cit.
Microstylis majanthemifolia Reichb. f. in Linnaea 22:834. 1849.
Microstylis cochleariaefolia Reichb. f. loc. cit.
Microstylis ichthyorrhyncha Reichb. f., Beitr. Orch. Centr.-Am. 99. 1866.
Achroanthes maianthemifolia Greene, Pittonia 2:184. 1891.
Microstylis elegantula Schltr. in Fedde Rep. Sp. Nov. 3:17. 1906.

Small, erect, terrestrial herbs from 1 to 4 dm. tall. Stem short, cormous or fleshy, covered with scarious sheaths. Leaves long-petiolate, one to each plant; lamina 2.5–12 cm. long and 2–9.5 cm. broad, ovate-cordate to broadly ovate-cordate, acute or obtuse, membranaceous; petiole elongated, sheathing and enclosing the peduncle for half its length (thus the lamina seemingly borne near the middle of the otherwise naked part of the peduncle). Inflorescence an elongate, many-flowered raceme. Dorsal sepal 2.5–3 mm. long and 1–1.5 mm. broad, elliptic-oval

to elliptic-ovate, obtuse or acutish. Lateral sepals 2.3–2.8 mm. long and about 1.5 mm. broad, oval, obtuse or acute, slightly arcuate, shortly connate at the base. Petals 2–3 mm. long and 0.3–0.7 mm. broad, linear-lanceolate, acute, slightly arcuate. Lip 2–3 mm. long and 1.5–2.5 mm. broad, ovate-cordate or triangular-cordate, acute or obtuse, somewhat concave. Anther bipartite with 2 fused pollinia in each part of it.

Mexico, Guatemala, Honduras, and Panama.

CHIRIQUÍ: Boquete, alt. 1515 m., *Davidson 801*; Casita Alta, Volcán de Chiriquí, alt. 1500–2000 m., *Woodson, Allen & Seibert 830*; Potrero Muleto de Volcán de Chiriquí, alt. 3500–4000 m., *Woodson & Schery 474*.

2. MALAXIS PITTIERI (Schltr.) Ames in Proc. Biol. Soc. Wash. 35:84. 1922.

Microstylis Pittieri Schltr. in Fedde Rep. Sp. Nov. 12:203. 1913.

Erect terrestrial herbs up to about 2 dm. tall. Stems short, fleshy or cormous, unifoliate. Leaves long-petiolate; lamina 2–3 cm. long and about 2–2.5 cm. broad, broadly ovate-cordate, acute or short-acuminate, membranaceous; petiole sheathing the lower half of the peduncle. Inflorescence a sublax, many-flowered raceme up to about 9 cm. long. Dorsal sepal 2.2–2.7 mm. long and about 1 mm. broad, elliptic-oblong, obtuse. Lateral sepals about 2–2.3 mm. long and together about 1.7 mm. broad, suborbicular-ovate, connate ¾ their length. Petals about 2.5 mm. long and 0.5 mm. broad, linear, acute or obtuse. Lip 2.2–2.5 mm. long and 2–2.5 mm. broad, 3-lobed, the disc cochleate and with a carinate U-shaped ridge in front; mid-lobe triangular-lanceolate; lateral lobes oblong-ovate.

Known only from Panama.

CHIRIQUÍ: between Alto de Las Palmas and the top of Cerro de la Horqueta, alt. 2100–2268 m., *Pittier 3277*.

A rare species, distinctive because of the lobing of the lip.

3. MALAXIS SOULEI L. Wms. in Ann. Missouri Bot. Gard. 21:343. 1934.

Microstylis montana Rothr. in Wheeler, Rept. U. S. Geog. Surv. W. 100th Merid. 6(Bot.):264. 1878.
Achroanthes montana Greene, Pittonia 2:183. 1891.
Malaxis montana O. Ktze. Rev. Gen. Pl. 2:673. 1891, non Blume.
Malaxis macrostachya "(La Llave & Lex.) O. Kuntze," sensu Ames & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 3:120. 1935, hardly of La Llave & Lexarza nor of Lindley nor of Kuntze.

Erect terrestrial herbs up to about 4.5 dm. tall. Stems short, fleshy or cormous, probably hypogaeous, covered with the scarious bases of the sheaths and petiole. Leaves 1 on each growth; lamina 2.5–16 cm. long and 1–6 cm. broad, elliptic-ovate to oblong or oblong-ovate to obovate, variable, acute or obtuse, membranaceous; petiole elongated and enclosing the peduncle for a third to a half of its length and thus the lamina borne well above the ground. Inflorescence an elongated, densely flowered spike. Dorsal sepal 1.5–2.5 mm. long and about 0.8–1.2 mm. broad, lanceolate-ovate to elliptic-oblong, acute or obtuse. Lateral sepals 1.5–2.2 mm. long and 0.8–1.2 mm. broad, oblong-elliptic, obtuse. Petals

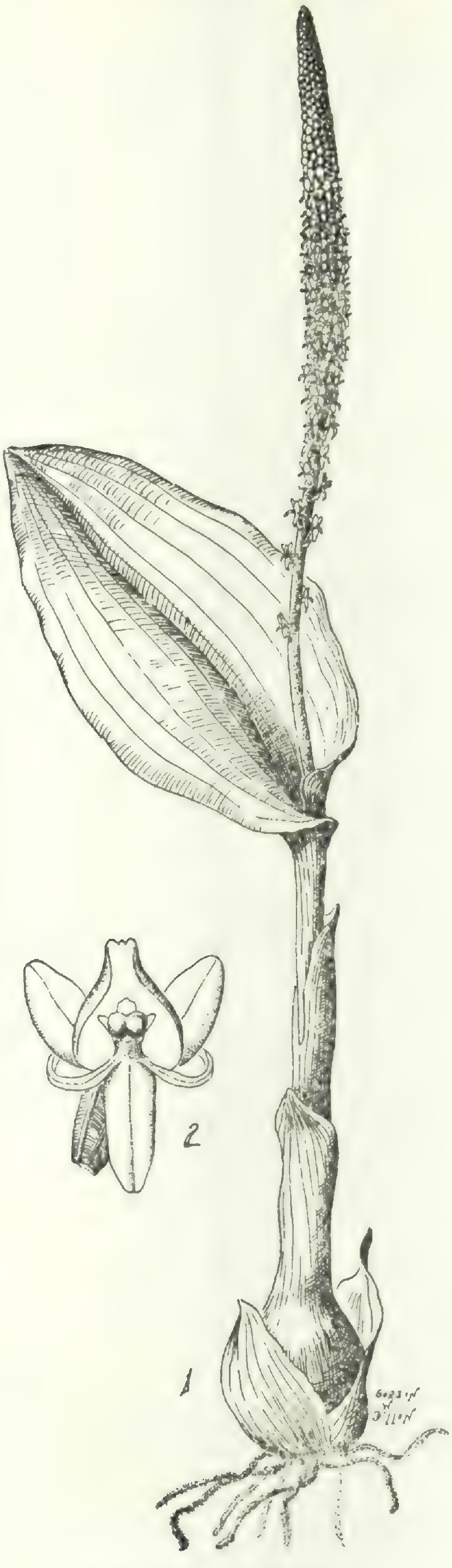


Fig. 117. *Malaxis Soulei*

1.2–2 mm. long and 0.2–0.6 mm. broad, linear or linear-lanceolate, obtuse. Lip 1.7–2.5 mm. long and 1.4–2.5 mm. broad, ovate-cordate to suborbicular-cordate, auriculate, cochleate, apex tridentate.

Arizona, Mexico, Guatemala, Costa Rica, and Panama.

CHIRIQUÍ: Volcán de Chiriquí, alt. about 3025 m., *Davidson 999;* Llanos del Volcán, alt. 1120–1200 m., *Seibert 128;* Casita Alta, Volcán de Chiriquí, alt. about 1500–2000 m., *Woodson, Allen & Seibert 804, 835;* Casita Alta to Cerro Copete, alt. 2300–3300 m., *Woodson & Schery 371.*

4. MALAXIS SIMILLIMA (Reichb. f.) O. Ktze. Rev. Gen. Pl. 2:673. 1891.

Microstylis simillima Reichb. f. Beitr. Orch. Centr.-Am. 101. 1866.

Erect terrestrial herbs up to about 3.5 dm. tall. Stems short, cormous, hypogaeous, bifoliate, covered with the scarious bases of the sheaths and petiole. Leaves long-petiolate; lamina 3.5–14 cm. long and 2–7 cm. broad, lanceolate-ovate to broadly ovate, acuminate, membranaceous, reaching to about the middle of the peduncle. Inflorescence a short, dense, many-flowered, subumbellate raceme. Dorsal sepal 3–4 mm. long and 1.2–1.8 mm. broad, broadly lanceolate or ovate-lanceolate, acute or obtuse. Lateral sepals 3–4 mm. long and 1–1.5 mm. broad, ligulate-lanceolate to elliptic-lanceolate, acute, connate to the middle or less. Petals 2–2.5 mm. long and 0.2–0.5 mm. broad, linear, acute or obtuse. Lip 3.5–4.5 mm. long and 1.5–3 mm. broad, ovate-lanceolate, acute, cochleate, with 2 small lateral or inframarginal teeth below the apex.

Costa Rica and Panama.

CHIRIQUÍ: Bajo Chorro, alt. 1900 m., *Woodson & Schery 685.*

5. MALAXIS EXCAVATA (Lindl.) O. Ktze. Rev. Gen. Pl. 2:673. 1891; L. Wms. in Bot. Mus. Leafl. Harv. Univ. 6:75. 1938.

Microstylis excavata Lindl. in Bot. Reg. 24:Misc. p. 51. 1838.
Microstylis hastilabia Reichb. f. Beitr. Orch. Centr.-Am. 101. 1866.
Malaxis hastilabia O. Ktze. loc. cit.
Microstylis Carpinterae Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:381. 1918.
Malaxis Carpinterae Ames, Sched. Orch. 7:157. 1922.
Malaxis uncinata Ames & Schweinf. Sched. Orch. 10:15. 1930.

Erect terrestrial herbs from a rhizome, up to about 4.2 dm. tall. Stems short, cormous, bifoliate, covered with the scarious sheaths of the petioles and bracts. Leaves long-petiolate; lamina 5–12 cm. long and 2–7 cm. broad, ovate-lanceolate to ovate, acute or acuminate, membranaceous, paired, reaching to about the middle of the peduncle; petioles sheathing the lower part of the peduncle. Inflorescence a short, dense, many-flowered, subumbellate raceme. Dorsal sepal 3.5–4 mm. long and 1.5–2.7 mm. broad, elliptic-oblong to ovate, obtuse. Lateral sepals 3–4 mm. long and 1.3–2.2 mm. broad, oblong-oval to oblong-ovate, obtuse, free to the base or nearly so. Petals 2.5–3.5 mm. long and 0.3–0.4 mm. broad, linear (or linear-lanceolate), obtuse. Lip 3–4 mm. long and 2.5–4 mm. broad, oblong-cordate to triangular-cordate, auricles at the base erect or uncinate, trilobulate at the apex, disc excavated and gibbous, the cavity with a longitudinal ridge.

Mexico, Costa Rica, Panama, Colombia, Ecuador, Peru, Bolivia, Argentina, and Brazil.

CHIRIQUÍ: Boquete, alt. about 3025 m., *Davidson 1002;* vicinity of Monte Lirio, alt. 1300–1900 m., *Seibert 175;* Casita Alta to Cerro Copete, alt. 2300–3300 m., *Woodson & Schery 368;* Potrero Muleto to summit of Volcán de Chiriquí, alt. 3500–4000 m., *Woodson & Schery 461.*

Description drawn from Central American material. Some South American specimens have smaller flowers. A variable species.

Fig. 118. *Malaxis Woodsonii*

6. MALAXIS WOODSONII L. Wms. in Ann. Missouri Bot. Gard. 26:281, *t. 21, figs. 1-2.* 1939.

Small terrestrial herbs up to about 15 cm. tall. Stems short, cormous, covered with the bases of the petioles and bracts. Leaves long-petiolate; lamina 1.5–5.5 cm. long and 1.3–4.5 cm. broad, broadly ovate, obtuse or acute, crenulate or obscurely serrate, membranaceous, borne about the middle of the peduncle. Inflorescence many-flowered, subumbellate. Sepals 2.5–4 mm. long and 1.5–2.5 mm. broad, broadly lanceolate, obtuse. Petals about 2.5–3 mm. long, filiform. Lip 3.5–5 mm. long and 3–3.5 mm. broad, quadrate in outline; apex 3-lobate, the mid-lobe small and exceeded by the lateral lobes in length, lateral lobes large, rounded, obtuse, the basal auricles linear-lanceolate, acute, erect; disc with two shallow cavities.

Panama.

CHIRIQUÍ: Casita Alta, Volcán de Chiriquí, alt. about 1500–2000 m., *Woodson, Allen & Seibert 831, 832.*

Well distinguished from all other species in Central America by the basal auricles of the lip.

7. MALAXIS FASTIGIATA (Reichb. f.) O. Ktze. Rev. Gen. Pl. 2:673. 1891; Ames & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 3:116. 1935.

Microstylis fastigiata Reichb. f. in Linnaea 22:834. 1849.
Microstylis brachyrrhynchos Reichb. f. in Flora 71:152. 1888.
Malaxis brachyrrhyncha Ames in Proc. Biol. Soc. Wash. 35:84. 1922, sphalm.
Malaxis Lankesteri Ames, Sched. Orch. 4:7. 1923.

Small erect terrestrial herbs up to about 6 dm. tall. Stems short, cormous, bifoliate, tunicate. Leaves long-petiolate; lamina 3–16.5 cm. long and 1.5–9.5 cm. broad, oval to broadly ovate, obtuse or acuminate, membranaceous, paired, reaching to about the middle of the peduncle; petiole sheathing the lower part of the peduncle. Inflorescence a many-flowered, short or rarely somewhat elongated, subumbellate raceme. Dorsal sepal 3–5 mm. long and 1–1.6 mm. broad, lanceolate to ovate-lanceolate, obtuse. Lateral sepals 3–4.5 mm. long and 1–1.8 mm. broad, lanceolate to elliptic-ovate, obtuse, free to their bases. Petals 2–3.5 mm. long and 0.3–0.4 mm. broad, linear or linear-ligulate. Lip 2–4 mm. long and 1.5–2.5 mm. broad, ovate-triangular to ovate-lanceolate, the apex from rounded to subrostrate, acute or obtuse, disc excavated and gibbous, fleshy, the cavity with a longitudinal ridge.

Mexico, Guatemala, Honduras, Costa Rica, and Panama.

CHIRIQUÍ: Llanos del Volcán, alt. 1120–1200 m., *Seibert 327.*

Malaxis fastigiata and *M. brachyrrhyncha* are often considered to be distinct species. The first is supposed to have the lip distinctly rostrate; the second is not supposed to be rostrate (although the type is short-rostrate). This seems to be the only method of separating the two and, as the two conditions intergrade completely, the two species should be considered synonymous.

8. MALAXIS PARTHONII Morr. in Bull. Acad. Roy. Brux. 5:485. 1838; L. Wms. in Ann. Missouri Bot. Gard. 26:281. 1939.

Microstylis histionantha Lk., Kl. & Otto, Ic. Pl. Rar. Hort. Berol. 1:11, *t. 5.* 1841; Hook.

in Bot. Mag. 70: *t. 4103.* 1844.
Microstylis Parthonii Reichb. f. in Walp. Ann. 6:206. 1861.
Microstylis Brenesii Schltr. in Fedde Rep. Sp. Nov. Beih. 19:167. 1923.

Erect terrestrial herbs up to about 6 dm. tall. Stems short, cormous, bifoliate, covered with the scarious bases of the petioles and bracts. Leaves 8–18 cm. long and 3–12 cm. broad, ovate-lanceolate to broadly ovate or suborbicular, acute or acuminate, membranaceous, paired, reaching to about the middle of the scape, their petioles sheathing the lower part of the peduncle. Inflorescence a short, many-flowered, subumbellate raceme. Dorsal sepal 4.5–6 mm. long and 1.5–2.5 mm. broad, lanceolate-ligulate to elliptic, obtuse. Lateral sepals 3–5 mm. long and together up to 6 mm. broad, connate to the middle or beyond or free to the base, suborbicular in outline or separately lanceolate-ovate, obtuse. Petals 2–4 mm. long, filiform. Lip 3.5–5 mm. long and 3.5–7 mm. broad, orbicular to transversely oblong-oval, concave toward the base.

Mexico, Salvador, Costa Rica, Panama; reported from Peru but a small-flowered form if so.

CANAL ZONE: vicinity of Salamanca Hydrographic Station, alt. about 80 m., *Woodson, Allen & Seibert 1581.* CHIRIQUÍ: Finca Lérida to Boquete, alt. 1300–1700 m., *Woodson, Allen & Seibert 1172.*

8a. MALAXIS PARTHONII Morr. var. DENTICULATA (Reichb. f.) Ames, Hub. & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 3:40. 1934.

Microstylis Parthonii Reichb. f. var. *denticulata* Reichb. f., Beitr. Orch. Centr.-Am. 100. 1866.
Microstylis Wercklei Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:382. 1918.
Malaxis Wercklei Ames in Proc. Biol. Soc. Wash. 35:85. 1922.

Much like the species except the floral parts smaller, the lip denticulate or ciliate and the cavity at the base of the lip definitely bipartite.

Costa Rica and Panama.

CHIRIQUÍ: vicinity of upper Río Chiriquí, Monte Lirio, alt. 1300–1900 m., *Seibert 170, 221;* valley of upper Río Chiriquí, alt. 1300–1900 m., *White & White 17;* vicinity of Casita Alta, alt. 1500–2000 m., *Woodson, Allen & Seibert 832bis.*

9. MALAXIS BLEPHARIGLOTTIS (Schltr.) Ames in Proc. Biol. Soc. Wash. 35:84. 1922.

Microstylis blephariglottis Schltr. in Fedde Rep. Sp. Nov. 12:202. 1913.

Small, erect, epiphytic (or terrestrial?) herbs up to about 4.5 dm. tall. Stems up to about 2 cm. long, densely leaved. Leaves 4.5–12 cm. long and 0.8–1.5 cm. broad, elliptic to oblanceolate-ligulate, acute or acuminate, membranaceous. Inflorescence densely flowered, elongated; bracts up to about 8 mm. long, lanceolate, acuminate, entire or lacerate, cucullate. Sepals 2.5–3 mm. long and 1–1.5 mm. broad, elliptic-lanceolate to elliptic-oblong, obtuse, slightly cucullate. Petals 3–3.5 mm. long and 0.4–0.6 mm. broad, linear-ligulate, obtuse. Lip 3–4 mm. long and 2–3 mm. broad, oblong-obovate, obtuse or acute, slightly constricted above the base, the base emarginate and callus thickened, margins ciliate or ciliate-lacerate.

Costa Rica and Panama.

CHIRIQUÍ: above El Boquete, alt. 1650–1925 m., *Maxon 5667*.

Known in Panama only from the original specimen although the locality has been often collected. This species, along with *Malaxis tipuloides* (Lindl.) O. Ktze., belongs to Schlechter's section BLEPHARIGLOTTIS of *Microstylis* (Schlechter, loc. cit. 203). The species of the section (perhaps a dozen) resemble some species of *Liparis* rather closely. The anthers are neither completely erect, as they are supposed to be in *Malaxis*, nor are they incumbent as in *Liparis*. The position of the anther in these genera is controlled by the length of the rostellum, and this species has a relatively long one. It is perhaps important that the pollinia of these two species have their long axis parallel to the long axis of the column, which doubtless indicates an anther nearly erect. The position of the anther has been used in separation because there is hardly a way in which the two genera may be distinguished. Perhaps the relative length of the column would afford a better criterion.

10. MALAXIS TIPULOIDES (Lindl.) O. Ktze. Rev. Gen. Pl. 2:673. 1891, as *Malaxis tipulodea*.

Microstylis tipuloides Lindl. in Ann. & Mag. Nat. Hist. 15:256. 1845.
Liparis eustachys Schltr. in Fedde Rep. Sp. Nov. Beih. 19:91. 1923.
Liparis fratrum Schltr. loc. cit. 92; L. Wms. in Ann. Missouri Bot. Gard. 27:282. 1940.
Liparis tipuloides Schltr. loc. cit. 91; C. Schweinf. in Bot. Mus. Leafl. Harv. Univ. 6:2. 1938.

Repent or ascending terrestrial herbs often with the stems rooting at the nodes, up to about 7 dm. long. Stems up to about 10 cm. long, densely leaved, slender. Leaves 5–17 cm. long and 0.9–3.5 cm. broad, elliptic to elliptic-oblanceolate, petiolate, acute, membranaceous. Inflorescence a loose or dense raceme up to about 5–6 dm. long, much exceeding the stems and the leaves. Dorsal sepal 5.5–6 mm. long and 1–2 mm. broad, ligulate, lanceolate, obtuse. Lateral sepals similar to the dorsal but somewhat arcuate. Petals 4.5–7 mm. long, linear or linear-lanceolate, obtuse or acute. Lip 5.5–9.5 mm. long and 3–4.5 mm. broad, elliptic-obovate, acuminate, auriculate, ciliolate, somewhat constricted below the middle.

Costa Rica, Panama, and Colombia.

CHIRIQUÍ: Cerro Punta, alt. 2000 m., *Allen 1528*.

See note on preceding species.

11. MALAXIS **Wendlandii** (Reichb. f.) L. Wms., comb. nov.

Liparis Wendlandii Reichb. f. Beitr. Orch. Centr.-Am. 98. 1866.

Small, caespitose, epiphytic herbs up to about 6 dm. tall. Stem a short cormous pseudobulb covered with fibrous sheaths and the bases of the petioles and bracts. Leaf 1, petiolate; lamina 0.9–2 cm. long and 0.5–1.2 cm. broad, oval to suborbicular, acute, membranaceous. Inflorescence a few-flowered raceme, the base enfolded by the petiole and the bracts. Dorsal sepal about 3–3.5 mm. long and 1.5–1.7 mm. broad, ovate-lanceolate, obtuse or acutish. Lateral sepals 2.7–3.2

mm. long and about 0.8–1.2 mm. broad, lanceolate to ovate-lanceolate, obtuse or acutish, somewhat arcuate. Petals about 3 mm. long and 0.6–0.7 mm. broad, linear-lanceolate, acute or acuminate. Lip 3–3.5 mm. long and 2–2.6 mm. broad, obovate-triangular, retuse, denticulate, with an umbonate callus toward the base. Column about 0.75 mm. long, at right angles to the lip; anther about 0.75 mm. long, erect or semi-erect, long-rostrate, the rostrum about 0.5 mm. of the length of the anther; rostellum very long.

Costa Rica and Panama.

CHIRIQUÍ: valley of the upper Río Chiriquí Viejo, vicinity of Monte Lirio, alt. 1300–1900 m., *Seibert 195, 216.*

Malaxis Wendlandii is a very curious plant which seems to have most of the technical characters of *Malaxis* but a lip like that of *Liparis*, in which genus it was originally placed. The short column, erect or semi-erect anther with separated cells and the long rostellum point to *Malaxis*. The rostrate anther is unusual. The shape of the lip certainly reminds one of the genus *Liparis*.

25. LIPARIS L. C. Rich.

LIPARIS L. C. Rich. in Mém. Mus. Par. 4:52, *t. 5, fig. 10.* 1818; Lindl. Gen & Sp. Orch. Pl. 26. 1830; Benth. & Hook. Gen. Pl. 2:495. 1883; Ridley in Jour. Linn. Soc. 22:252-297. 1886.

Small terrestrial or epiphytic herbs with pseudobulbous stems. Leaves few (1–4), petiolate, the base of the petiole enclosing the pseudobulb; lamina membranaceous (in Panama), usually broad. Inflorescence a few- to several-flowered, terminal raceme. Flowers small. Sepals free, subequal, spreading. Petals subequal to the sepals or usually smaller and narrower. Lip erect or spreading, shortly adnate to the base of the column or free, sessile or usually shortly clawed, entire or usually emarginate, 1- to 2-tuberculate at the base, broader than the sepals. Column elongated (compared to that of *Malaxis*), arcuate, semi-terete, footless, usually parallel to the axis of the lip; anther terminal, operculate, incumbent, usually soon deciduous and versatile; pollinia 4, waxy, their long axis at right angles to the long axis of the column or nearly so.

About 200 species in tropical and temperate regions with the greatest concentration in tropical Asia and Oceania. Closely allied to *Malaxis*.

1. LIPARIS ELATA Lindl. in Bot. Reg. 14: *t. 1175.* 1828; L. Wms. in Ann. Missouri Bot. Gard. 26:282. 1939.

Terrestrial herbs from 13 to 40 cm. tall. Stems short, becoming fleshy or cormous, sheathed with the bases of the petiole. Leaves petiolate, usually 3 or 4 from each stem, rosulate; lamina 5–30 cm. long and 2.5–11 cm. broad, elliptic-oval to ovate, acute or acuminate, membranaceous. Inflorescence a more or less lax, few- to many-flowered raceme. Dorsal sepal 6–7 mm. long and 2–2.2 mm. broad, oblong-lanceolate, obtuse. Lateral sepals 4–6 mm. long and 2–3 mm. broad, oval to ovate, obtuse, arcuate. Petals 5–5.7 mm. long and 1–1.5 mm.

Fig. 119. *Liparis elata*

broad, linear to linear-oblanceolate, obtuse, arcuate. Lip 4–5.5 mm. long and 4–5 mm. broad, obovate to flabellate, truncate or emarginate, fleshy, bituberculate at the base. Column long, arcuate.

Florida, Mexico, Guatemala, Honduras, Costa Rica, Panama, the West Indies, Brazil, Colombia, and Peru.

CANAL ZONE: Quebrada Salamanca, alt. 70 m., *Dodge, Steyermark & Allen 16988;* Salamanca Hydrographic Station, Río Pequeñí, alt. about 80 m., *Woodson, Allen & Seibert 1580.* PANAMÁ: Cerro Campana, alt. 600–800 m., *Allen 2677;* foothills east of city, *Powell 243.*

A widespread and somewhat variable species.

26. HEXISEA Lindl.

HEXISEA Lindl. in Hook. Jour. Bot. 1:7. 1834.

Euthonaea Reichb. f. in Bot. Zeit. 10:772. 1852.

Caespitose epiphytic herbs. Stems simple or branched, terete or angled, segmented, thickened or pseudobulbous. Leaves few, usually one or two from the apex of each segment, usually deciduous annually. Inflorescence from the apex of the growths, few-flowered, short; flowers small but highly colored. Sepals similar, erect or spreading, narrow, the laterals often shortly connate at the base. Petals similar to the sepals. Lip simple or lobulate, adnate at the base with the column, base of the lamina geniculate and usually callus-thickened. Column short, adnate to the lip below the middle; clinandrium 3-lobed; anther operculate, incumbent; pollinia 4, collateral, waxy.

About a half dozen species in Central and South America. Living material should prove instructive as to the origin of the inflorescence and new growth, for both apparently come from the apex of the preceding growth, which is somewhat unusual. The monotypic genus *Alemania* Llave & Lex. (The only one of the Llave & Lexarza orchids for which a type is known to exist) should possibly include *Hexisea.* Florally they are not to be distinguished but the vegetative growth may keep them separate until more is known about them.

1. HEXISEA BIDENTATA Lindl. in Hook., Jour. Bot. 1:8. 1834.

Diothonaea imbricata Lindl. Sert. Orch. *t. 40, f. 1.* 1841.
Epidendrum oppositifolium Rich. & Gal. in Ann. Sci. Nat. III, 3:21. 1845.
Diothonaea oppositifolia Reichb. f. in Linnaea 22:842. 1849.
Euthonaea oppositifolia Reichb. f. in Bot. Zeit. 10:772. 1852.
Euthonaea imbricata Reichb. f. loc. cit.
Hexisea oppositifolia Reichb. f. in Walp. Ann. 6:470. 1862.
Hexisea imbricata Reichb. f. loc. cit.

Caespitose epiphytic herbs up to about 4 dm. tall. Stems segmented, the terminal growth producing flowers and then a new growth and leaves from its apex, simple or branched, the segments subcylindric or fusiform. Leaves 2.5–16 cm. long and 0.3–1 cm. broad, linear to linear-ligulate, obtuse or retuse, coriaceous, borne from the apex of the segment of the stem. Inflorescence a short,

few-flowered raceme. Flowers usually bright red. Sepals 10–14 mm. long and 2.5–4 mm. broad, lanceolate or elliptic-lanceolate, acute, the laterals somewhat oblique. Petals 10–13 mm. long and 2–3 mm. broad, linear-lanceolate to linear-oblong, acute. Lip 8–13 mm. long and 2.5–4 mm. broad, oblong-oblanceolate, obtuse or acute, base of the lamina geniculate and the angle or "knee" usually callus-thickened, claw adnate with the basal half of the column.

Mexico, Honduras, Nicaragua, Costa Rica, Panama, Colombia, and British Guiana.

CHIRIQUÍ: "Chiriquí," alt. 1200 m., *Powell 64, 3113, 3156, 3157, 3161, 3190, 3192, 3214, 3504*. PANAMÁ: San Juan Hills, east of Panama City, *Powell 333, 3146, 3420*; "Panama": Panama et Colombia occidentalis, in 1831, *Cuming 1297*. VERAGUAS: headwaters of the Río Cañazas, alt. 300–600 m., *Allen 195*; Bahia Honda, *Taylor 1509*.

The genus should possibly be referred to *Alemania* Llave & Lex.

(To be concluded in Part III, Fasc. 3)

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CONTRIBUTIONS TO OUR KNOWLEDGE OF AMERICAN CARBONIFEROUS FLORAS

VIII. Another Medullosa from Iowa

HENRY N. ANDREWS
and JULES A. KERNEN[1]

In the last number of this "Carboniferous Flora" series (Andrews, '45) it was mentioned that xylary fragments of a rather large Medullosan stem were present in a collection of coal balls received from Mr. Frederick O. Thompson, of Des Moines, Iowa; and that while they apparently represented a distinct species they were not sufficiently complete to warrant description. A few weeks after this was published Mr. Thompson sent us another collection of coal balls which included an interesting Medullosa, and this specimen consists of a stelar system that appears worthy of its own alcove in the archives of pteridosperm stem remains.

Perhaps the most disturbing feature connected with coal ball studies is the necessity of casting a decision occasionally as to when to stop and record newly acquired information. One must necessarily draw a line somewhere between the extremes of describing each fragment as it turns up or of waiting indefinitely for a more or less complete set of fossils to accumulate. Unfortunately, the latter may never happen. A statement of Dr. Cannon's in his recent book (Cannon, '45), that "Since no research can be final, every publication is a progress report," seems most appropriate to coal-ball investigations.

The Iowa coal-ball plants previously described (Andrews, '45) were obtained from the Urbandale mine, the location of which is noted on the accompanying map (text-fig. 1). The present specimen, however, was collected from the Shuler coal mine a few miles to the west of the Urbandale mine. The exact location of the Shuler shaft is: 8 miles west of 63rd Street (Des Moines) and 1.2 miles north of U. S. Highway No. 6. The coal vein lies 610 feet above sea level, and 387 feet beneath the surface of the ground which has an elevation of 997 feet.

[1] Student at Southwest High School, St. Louis.

Issued April 30, 1946.

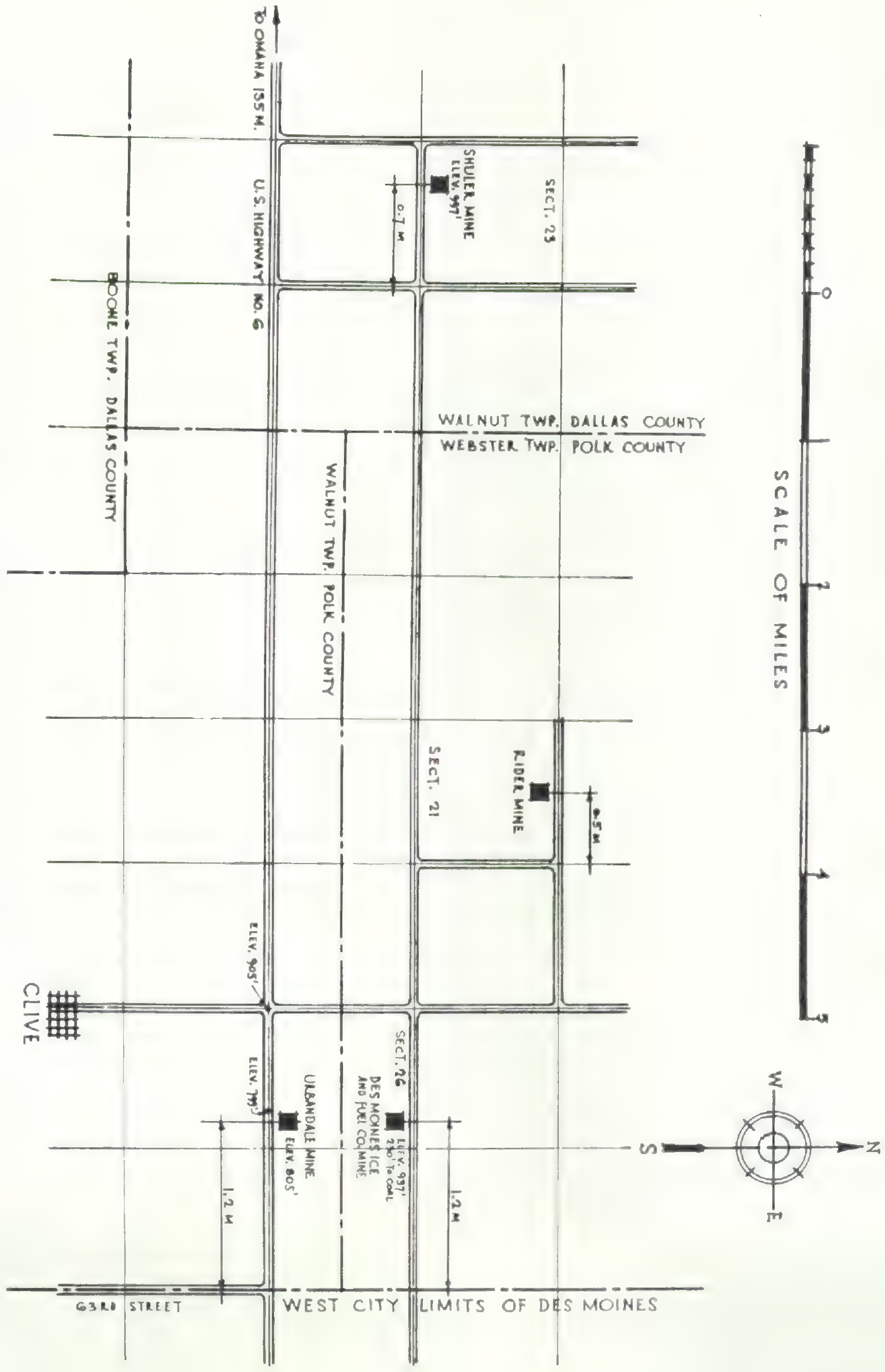
Some question has prevailed as to whether the veins worked by the Shuler and Urbandale mines are continuous. Recently we have been informed by Mr. Charles Bendixen, an official of the Shuler Mine, that drill holes show that the Shuler coal disappears entirely to the east toward the Urbandale mine. There is also some evidence to indicate that the Des Moines Ice and Fuel Co. coal does not extend to that worked by the Shuler mine. However, in view of the general similarity of the fossil floras from the two mines (Shuler and Urbandale), the fact that the shafts are but six and one-half miles apart and that there is a difference of only ten feet in the elevation of the veins at the position of the respective shafts, it seems likely that they represent contemporaneous Pennsylvanian forests. A more precise statement must await the publication of recent stratigraphic studies.

Inasmuch as we may reasonably expect more paleobotanical contributions from this region the accompanying map is presented to show the exact geographical position of the productive mines.

Medullosa anglica var. *ioensis*, var. nov.

The single specimen available consists of a stelar system composed of three steles (pl. 1, fig. 1). Although slightly crushed, they were all of approximately the same size in life. The best-preserved one (fig. 2) measures 18 x 10 mm. in transverse section. These measurements are limited by the secondary xylem, the tissues external to which (except for the partly preserved secondary phloem) being absent. The primary xylary body of this stele is somewhat crushed and distorted but apparently measured about 2 mm. in diameter in life. The radial development of the secondary xylem in two of the steles is fairly uniform, while the third (fig. 1c) displays pronounced endocentricity. The rather weak development and loose organization of the xylem on one side of stele *a* (fig. 1) is apparently the result of stelar branching.

Although the endocentric stele is crushed, the primary xylary body is, for the most part, intact (fig. 3). The relative amount of parenchyma associated with the primary tracheids is markedly greater than that in either M. *anglica* or M. *Thompsonii.* In the latter the primary body consists almost entirely of tracheids, while in M. *anglica* there is a somewhat greater admixture of parenchyma. According to Scott's account of the English species: "The whole interior of each stele . . . . is occupied by the primary wood, which consists of elements of two kinds—tracheides and parenchymatous cells. The arrangement and relative proportions of the two constituents vary much in different steles, and in different parts of the same. At some places, the tracheides form a continuous system over a considerable area, only interrupted by scattered strands of parenchyma . . . . In other cases the tracheides are arranged in definite groups, separated from one another by a network of parenchyma . . . ., while sometimes the cellular tissue predominates, and is traversed by comparatively few tracheides, isolated, or in small groups . . . . In no case is there any differentiation of a true 'partial pith,' or even any marked increase in the amount of parenchyma towards the middle of the stele." [Scott, '99, p. 88].



Text-fig. 1. Map showing coal mines near Des Moines, Iowa, where coal balls have been found. By Frederick O. Thompson.

It is evident from Scott's description that the primary xylem in the steles of *M. anglica* presents appreciable variation with respect to the tracheid-parenchyma ratio. In view of the size variation in the steles this might be expected according to Bower's ('30) size and form principles. However, in the three major steles composing the stem of *M. anglica*, the primary bodies appear (Scott, '99, pl. 6, photo 5) to be of about the same areal size and the tracheid-parenchyma ratio seems to be uniform in all. Comparing that figure with a corresponding one of *M. anglica* var. *ioensis*, two features are noticeable: first, the primary body in the steles of the Iowa specimen is much crushed which in itself would suggest relatively more of the delicate thin-walled conjunctive parenchyma, and second, where the primary wood is well preserved (fig. 3) the relative paucity of tracheids is conspicuous. The crushed nature of the primary tissues of *M. anglica* var. *ioensis* makes it impossible to make an accurate size comparison with *M. anglica*.

The radial walls of the secondary tracheids are composed of closely compacted and, for the most part, irregularly arranged bordered pits (fig. 5), an organization so characteristic of many supposed pteridosperms. Individually the pits vary from oval to an irregularly angular outline where they are most closely compacted. Occasionally they are nearly hexagonal, tending to be arranged in vertical rows. In a few cells the pit orifices are remarkably well preserved, being slender, horizontally orientated slits (fig. 4).

The wood rays, which may be classified in group IIB (Andrews, '40), are very narrow, being one to three cells wide, and of great height, exceeding 6. mm.

Associated with the steles, although not organically connected, are two small segments of the outer cortical rind of a Medullosan stem or petiole. While the epidermis of these fragments is missing, the general organization of the fibrous strands and of the enclosing parenchyma resembles that of *M. anglica*. In one of the two fragments secretory canals are especially abundant, abutting on nearly every fibrous strand, and present an appearance not unlike that of *Myeloxylon Bendixenii* (Andrews, '45, pl. 7).

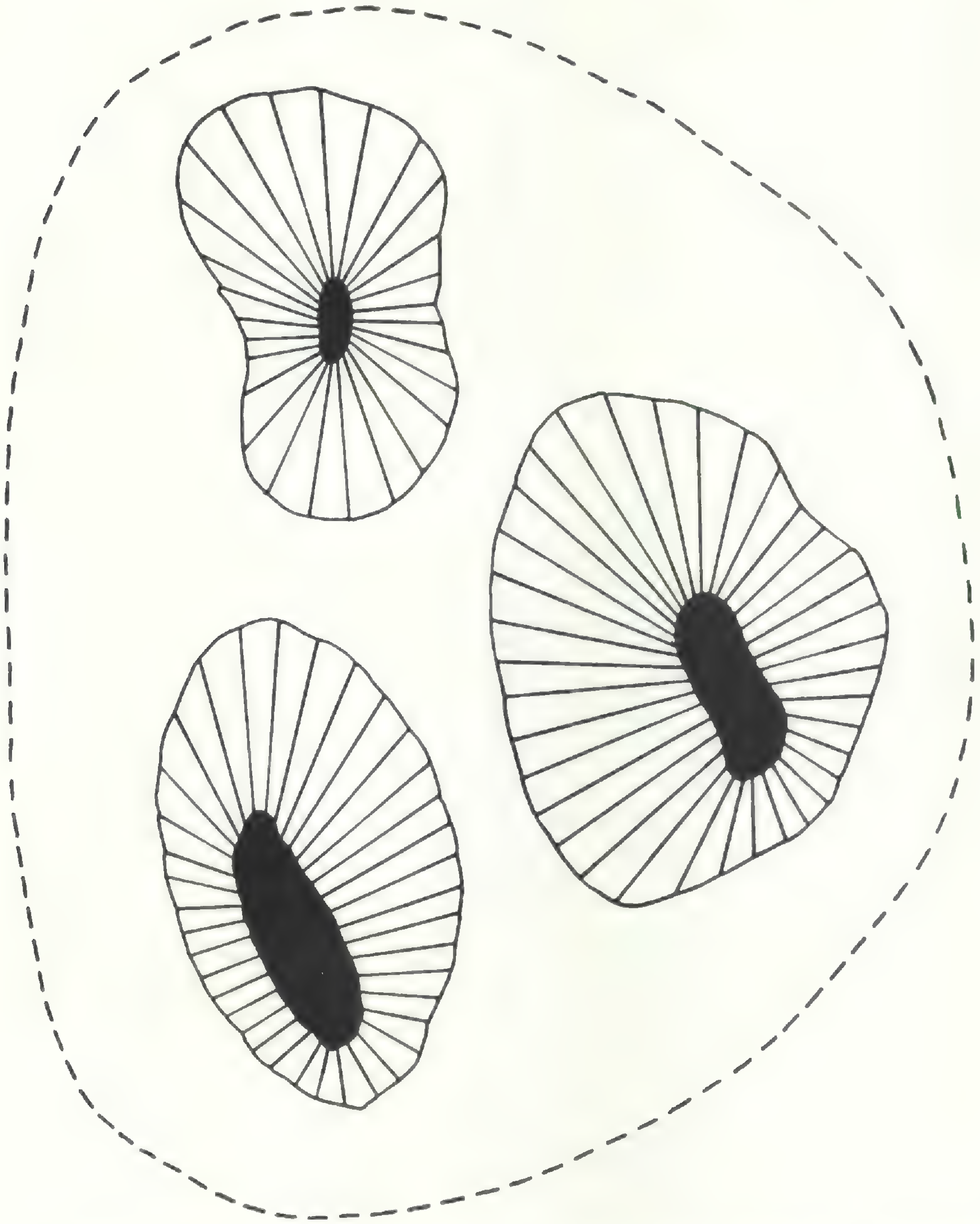
Locality: Shuler Coal Mine, Des Moines, Iowa.

Horizon: Des Moines Series, Pennsylvanian.

Type specimen: No. WCB425, Henry Shaw School of Botany, paleobotanical collections.

Discussion.—

There are now some eight species and varieties assigned to the Anglorota section of *Medullosa*. Whether or not these will all retain their present taxonomic distinction in the light of a future monographic study is a decision that we are not obliged to meet at the moment. There already exists a most interesting series of stems displaying significant, although more or less intergrading, anatomical variations. Some of these are perhaps only physiological variations while others appear to carry more taxonomic weight. Until more information has accumulated con-



Text-fig. 2. A diagram showing the (somewhat restored) stelar system of *Medullosa anglica* var. *ioense*. The primary xylem is indicated in solid black, the secondary xylem by radiating lines, and the probable position of the stelar periderm by the dotted line. This diagram has been prepared at a magnification of x 2.8 to facilitate comparison with other members of the Anglorota group shown in pl. 12 of Part VII of this series (Andrews, '45).

cerning this most important Pennsylvanian genus it seems most expedient to take advantage of even relatively slight structural differences.

In the account of *Medullosa Thompsonii* considerable weight was placed on the anatomy of the cortical tissues, particularly the fibrous strand-secretory canal relationship. However, since this tissue is lacking in the present specimen we are

handicapped in making a precise comparison. If the two associated cortical fragments belong with the stelar system they present characters, correlating with those of the primary wood, that clearly separate them from *Medullosa Thompsonii*. In both of these characters the new stem lies closest to the English *M. anglica*.

The qualitative differences separating the species of this group as a whole are by no means striking yet there are good reasons for believing that, such as they are, they may be of sound taxonomic validity. First, it is well known that stem anatomy in general is of a more conservative nature than that of other plant organs such as foliage or reproductive structures. Second, the Iowa coal balls contain a considerable variety of seeds, a number of which are, in all probability, those of pteridosperms.

It is a trifle embarrassing that the present report had to be given separately so soon after the previous account of Iowa Medullosas. On the other hand, we are not averse to hoping that future discoveries will render possible a continuation of these reports regardless of how long or short the intervals may be.

Acknowledgment.—

Thanks are again due to Mr. Frederick O. Thompson for his vital and continued interest in furthering these investigations.

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Explanation of Plate

PLATE 1

Medullosa anglica var. *ioense*

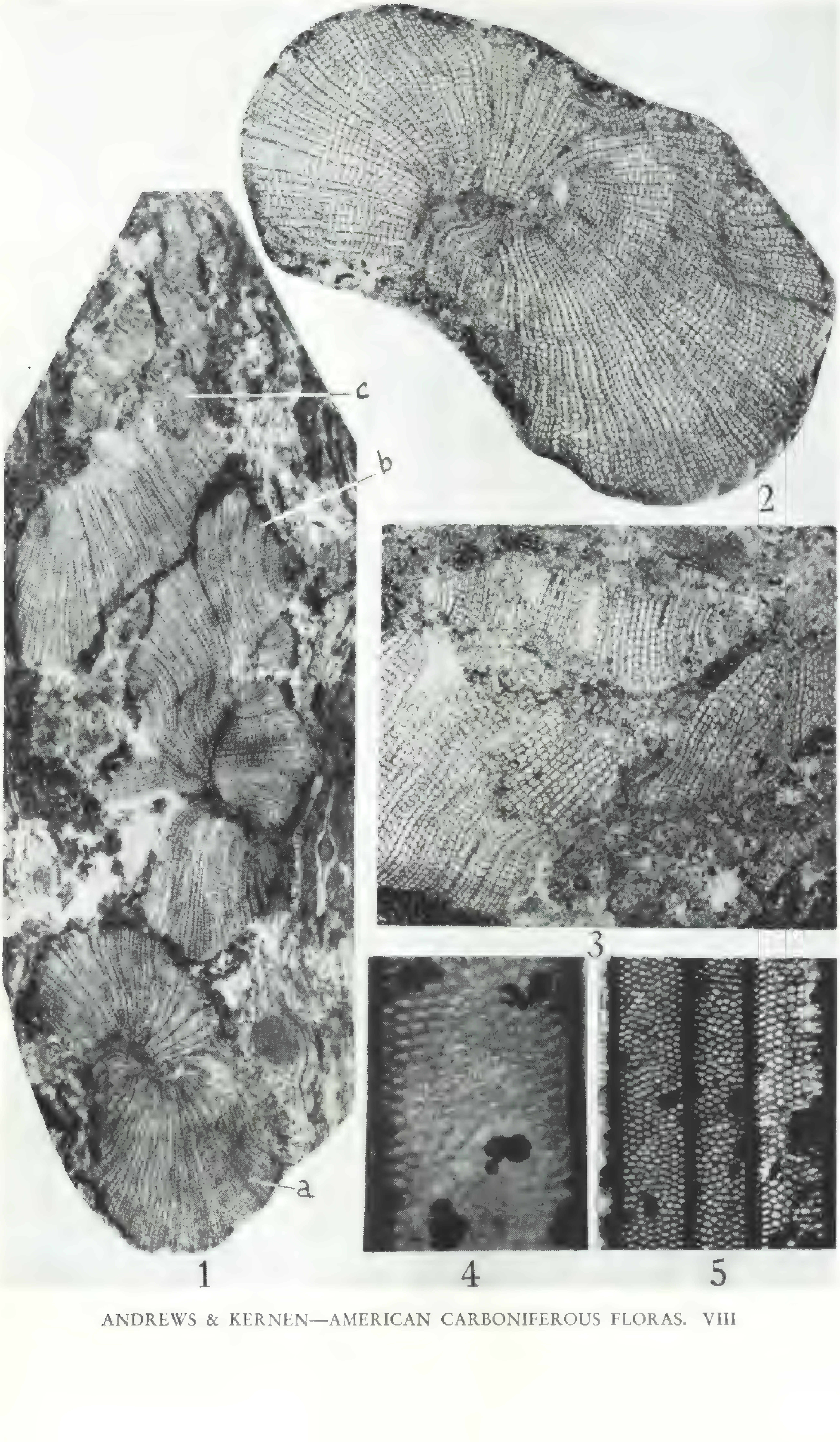
Fig. 1. The stelar system in transverse section. Slide 1391, x 2.8.

Fig. 2. Stele *a* shown at a higher magnification. Slide 1391, x 5.0.

Fig. 3. A portion of the endocentric stele *c* showing the primary xylem and part of the secondary tissues. Slide 1391, x 5.8.

Fig. 4. Radial view of part of a secondary tracheid showing the slit-like, nearly horizontal orifice of the pits. Slide 1392, x 125.

Fig. 5. Radial view of part of three secondary tracheids showing the arrangement of the pits. Slide 1392, x 66.



ANDREWS & KERNEN—AMERICAN CARBONIFEROUS FLORAS. VIII

MAIZE IN MEXICO
A PRELIMINARY SURVEY[1]

EDGAR ANDERSON

Mexico, even more than any other country of the New World, is the land of maize. There it is the actual staff of life, directly, as well as indirectly, for the vast majority of the inhabitants. Today, as in pre-historic times, the state of the maize crop is the commonest subject for conversation throughout the Republic. Maize is so thoroughly identified with Mexico that a survey of the varieties grown there might be useful to historians, geographers, and anthropologists, as well as to agronomists and geneticists. To students of maize in the United States the Mexican varieties have a special significance. Nearly all of the maize now being grown here must trace back, though often by very complex routes, to varieties once grown in Mexico. Some of the problems of commercial maize breeding in the United States and some of our archaeological problems cannot be solved until we have a more complete understanding of the maize of Mexico.

Any attempt to get a general over-all picture of Mexican maize is a difficult problem. Maize in Mexico is extremely variable; it not only varies in the same way that it does in the United States and with greater magnitude; in Mexico there are further patterns of variation. In the corncrib or the field it varies from plant to plant as do our open-pollinated (i. e., non-hybrid) varieties, but the variation is nearly always greater than in an American cornfield or corncrib. In one Mexican village it often varies widely from field to field for the same variety. Unlike American maize, there are, in addition, great differences between varieties and from region to region. There are frequently as many major kinds of maize in one Mexican village as in the entire United States, yet when one goes to a village in another part of Mexico he may find quite another set of varieties. For instance, there are shown in figure 1 the varieties grown by two Mexican families; one (above), in Toluca near Mexico City; the other (below), from west of Autlán in Jalisco. It is unfortunate that photographs of the plants could not have been included in the picture since variation in plant type was even more extreme than that in ear type. A careful comparison of these two pictures will show that several quite distinct varieties are being grown by each family. Yet none of those grown in Toluca are found in Autlán or vice versa. As a matter of fact, progressive farmers and agronomists in either of these regions know little or nothing about the types of maize grown in the other. The ear at the left in fig. 1 (No. 1 below) belongs to an ancient, well-established type of maize widely grown

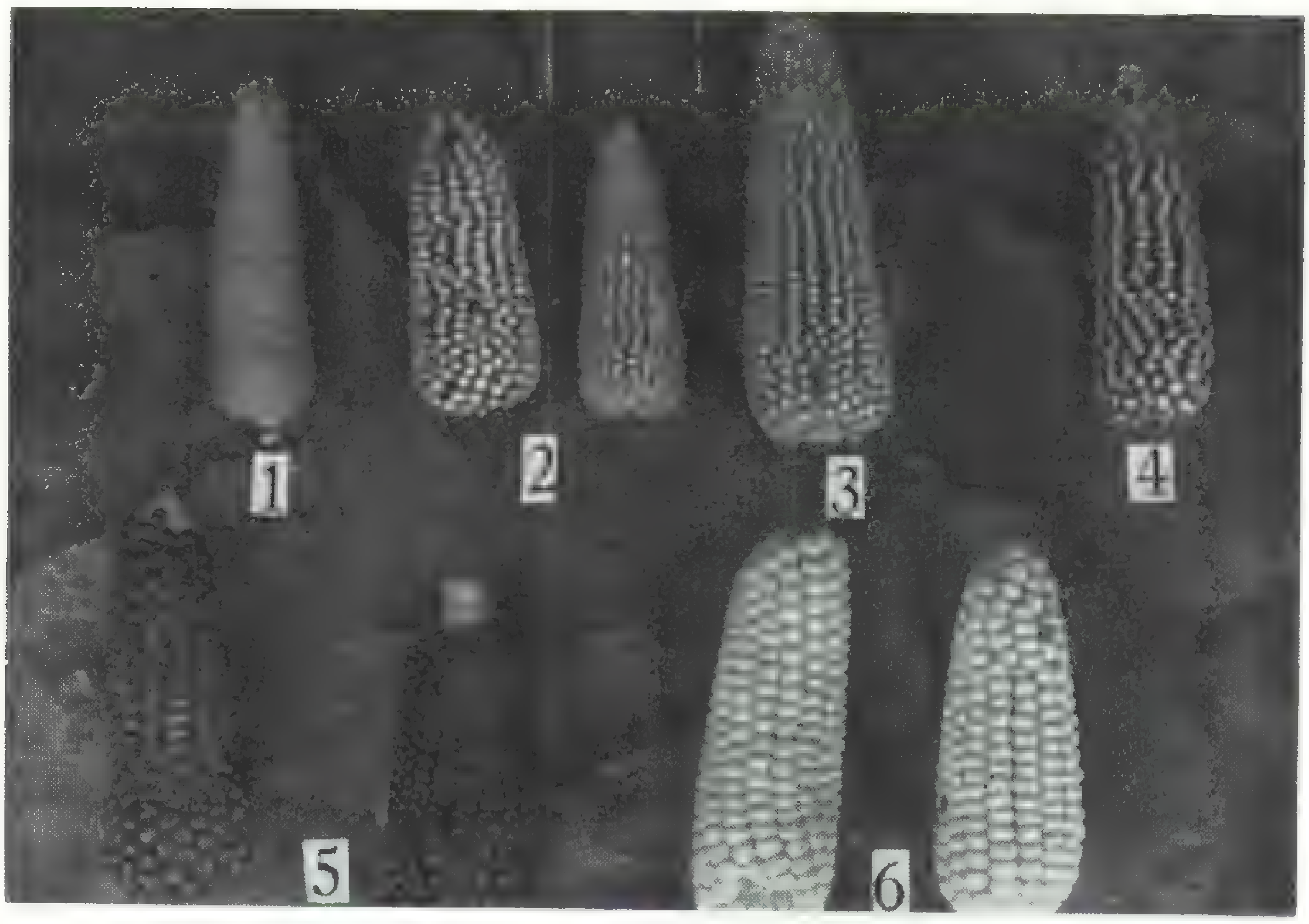
[1] Respectfully dedicated to the maize growers of Mexico who received me with uniform courtesy and furthered these studies in their cornfields and store-houses. Much of the work reported herein was carried on while the author was a Fellow of the Guggenheim Foundation. Acknowledgments are also due to Carl Sauer, Ralph Beals, Isabel Kelly, R. H. Barlow, and E. J. Wellhausen for large and significant collections of Mexican maize turned over to me for study.

in western Mexico (Anderson, 44a). When studying the maize of the Toluca-Mexico City region, ears of this variety were carried about and shown to farmers, plant breeders, and other agriculturists. All were much interested, but none recognized it or knew anything about the general type of maize to which it belonged. Similarly, the small rice popcorns of fig. 1 (above) were carried back from Toluca to Jalisco where they created general amazement when shown to the maize growers of that region, yet the air-line distance between Autlán and Toluca is only 300 miles.

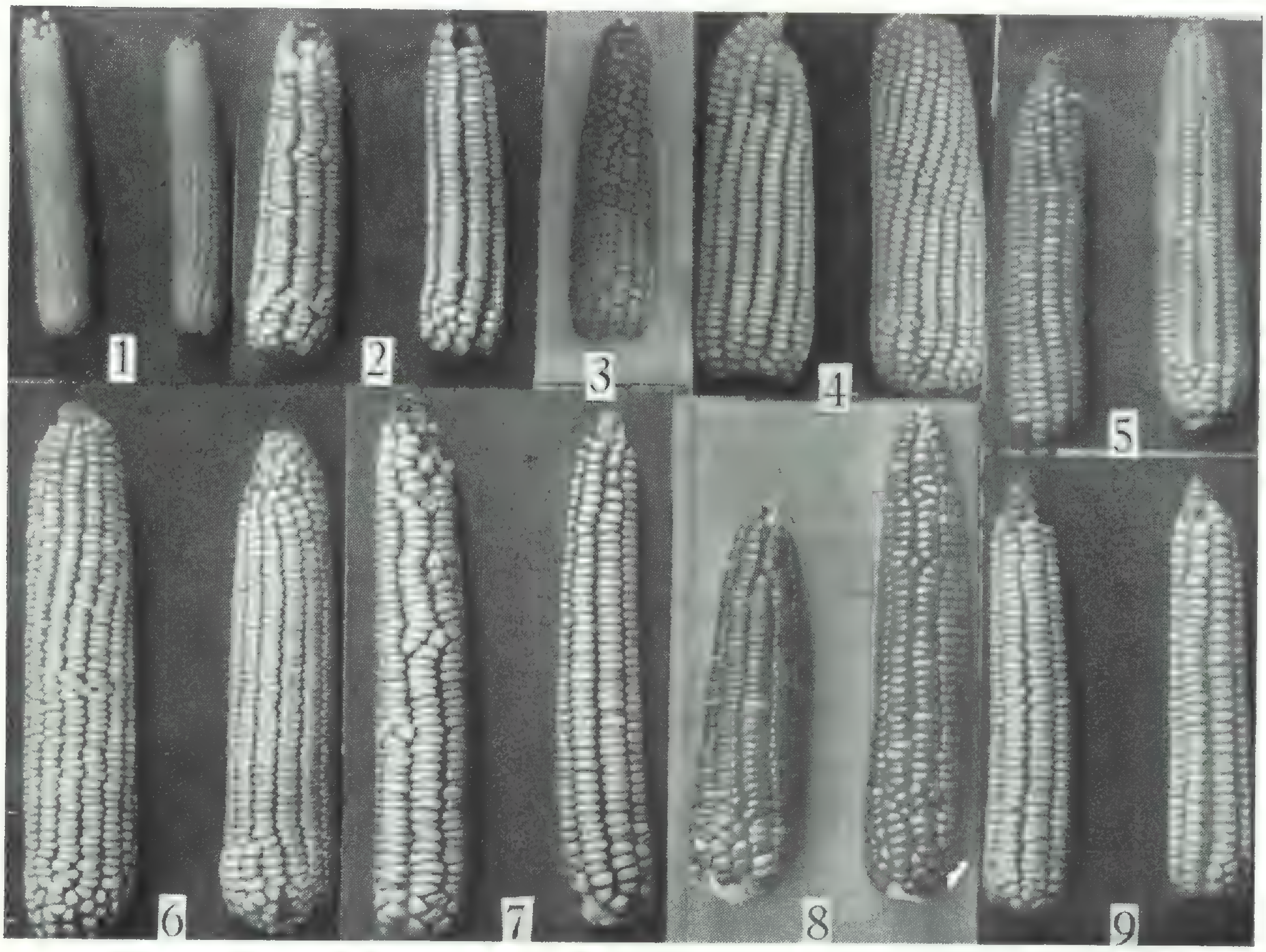
With regional variation piled upon local variation in this fashion, cataloguing the maize of Mexico and discussing the results in general terms is a research problem of no mean dimensions. It is indeed as if one were called upon to discuss the physical anthropology of Europe before any of the technical papers upon that subject had been published (Anderson and Cutler, '42). The present paper is little more than a first approximation. It is based upon six months of residence and travel in Guadalajara and Mexico City and the regions between them, plus five seasons of study in the laboratory and the experimental field of collections made by various collaborators. It scarcely even touches upon such important centers as Oaxaca, Chiapas, and the *barrancas* of western Mexico.

In studying Mexican maize it becomes immediately apparent that the customary pigeon-holes of maize agronomists (popcorn, sweet corn, dent corn, pod corn, flour corn, flint corn) are worse than useless. When these names were set up by E. Lewis Sturtevant in 1884 he dignified them with Latin equivalents, and they have therefore been taken more seriously as outlining real natural entities than he himself ever intended. They will serve as pigeon-holes in most of the United States, though they are artificial and do not divide *Zea Mays* into natural subdivisions. In Mexico they are bad even as pigeon-holes, and furthermore the different ones are bad in different ways. Flint and flour are single gene differences. In regions where both kinds are being grown (Ameca, Jalisco, for example) this single difference may occur in the same field and on the same ear so that shelled kernels from a single ear would have to be classified in two different groups by this system. Pod corn is likewise a single gene difference and, though seldom met with in Mexico, it might be expected to turn up in any kind of maize which was being grown. Sweet corn too is a single gene difference. In the case of Mexican sweet corn this character becomes still less reliable, since Mexican dents carry suppressors which may prevent the sweet character from showing even when it has been inherited.

Dent corns and popcorns however, differ from non-dents and non-pops by a considerable number of genes, and the names delimit more or less natural entities. Yet neither one will serve efficiently in cataloguing Mexican maize. The dent corns vary among themselves in the amount of denting, and they have been so hybridized with non-dented sorts that the classification into dents and non-dents is difficult and subjective in many parts of Mexico. Popcorns are more a group by themselves, or rather two groups. The two most different varieties of corn in



The six varieties of maize grown by one family near Toluca, Mexico: 1, one ear of popcorn; 2, two ears of pop-dent; 3, large yellow pop-dent; 4, pointed yellow corn with flushed pericarp; 5, two ears of "elote" corn; 6, two ears of "cacahuazintle."



Nine varieties common at Purificación, west of Autlán, Jalisco, two ears of each variety: 1, "reventador"; 2, "tabloncillo"; 3, "dulce" (only one ear); 4, "tampenqueño"; 5, "amarillo"; 6, "cuamillero"; 7, "umado" (probably "humiado"); 8, "negro"; 9, "blanco."

FIGURE 1

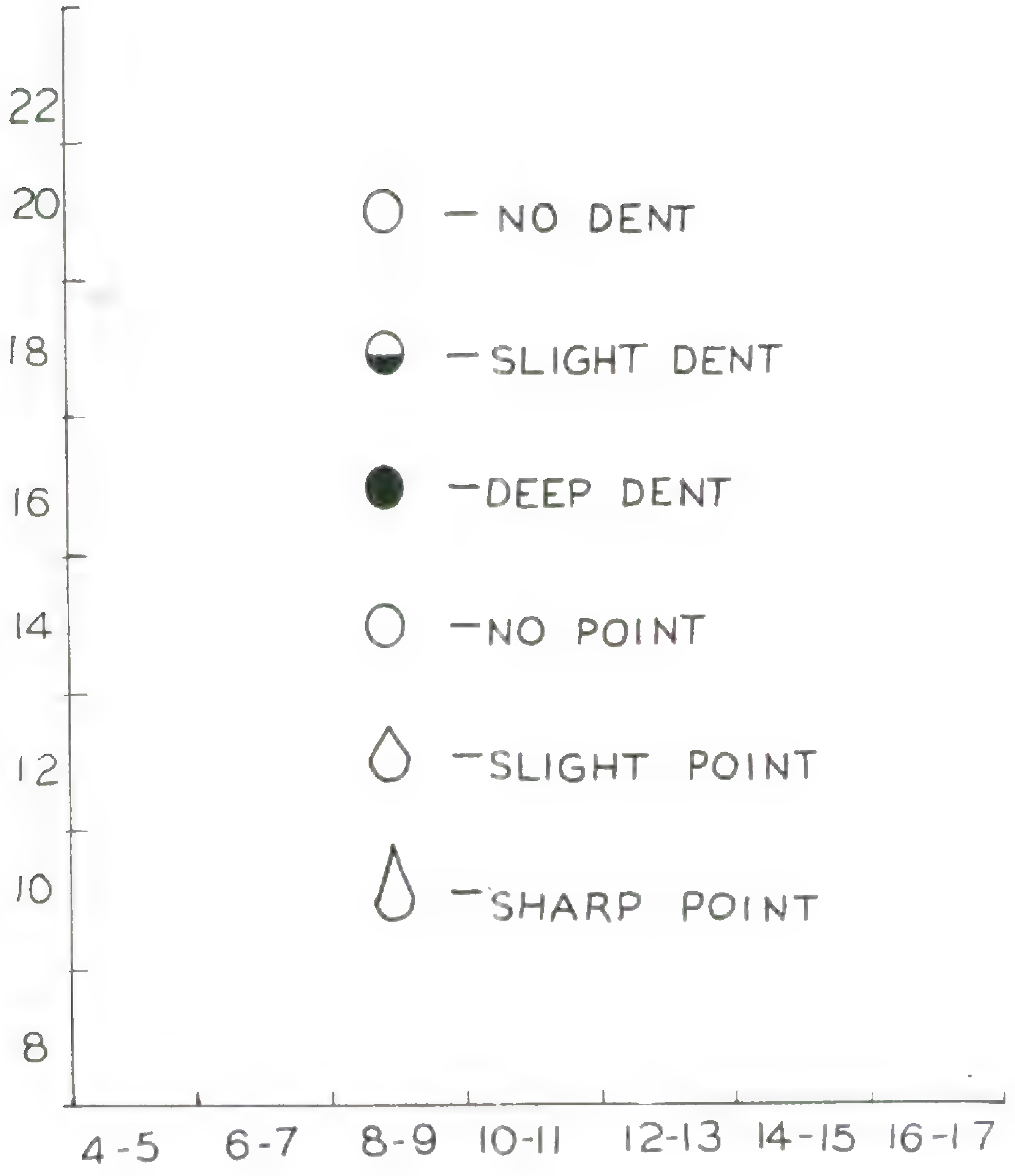


Fig. 2. Grid used throughout this paper and the Appendix for diagramming variation in Mexican maize. Vertical scale, row number; horizontal scale, width of the kernel in mm. The six diagrams illustrate how variation in denting and in pointing of the kernel is represented. Further explanation in the text and in the foreword to the Appendix.

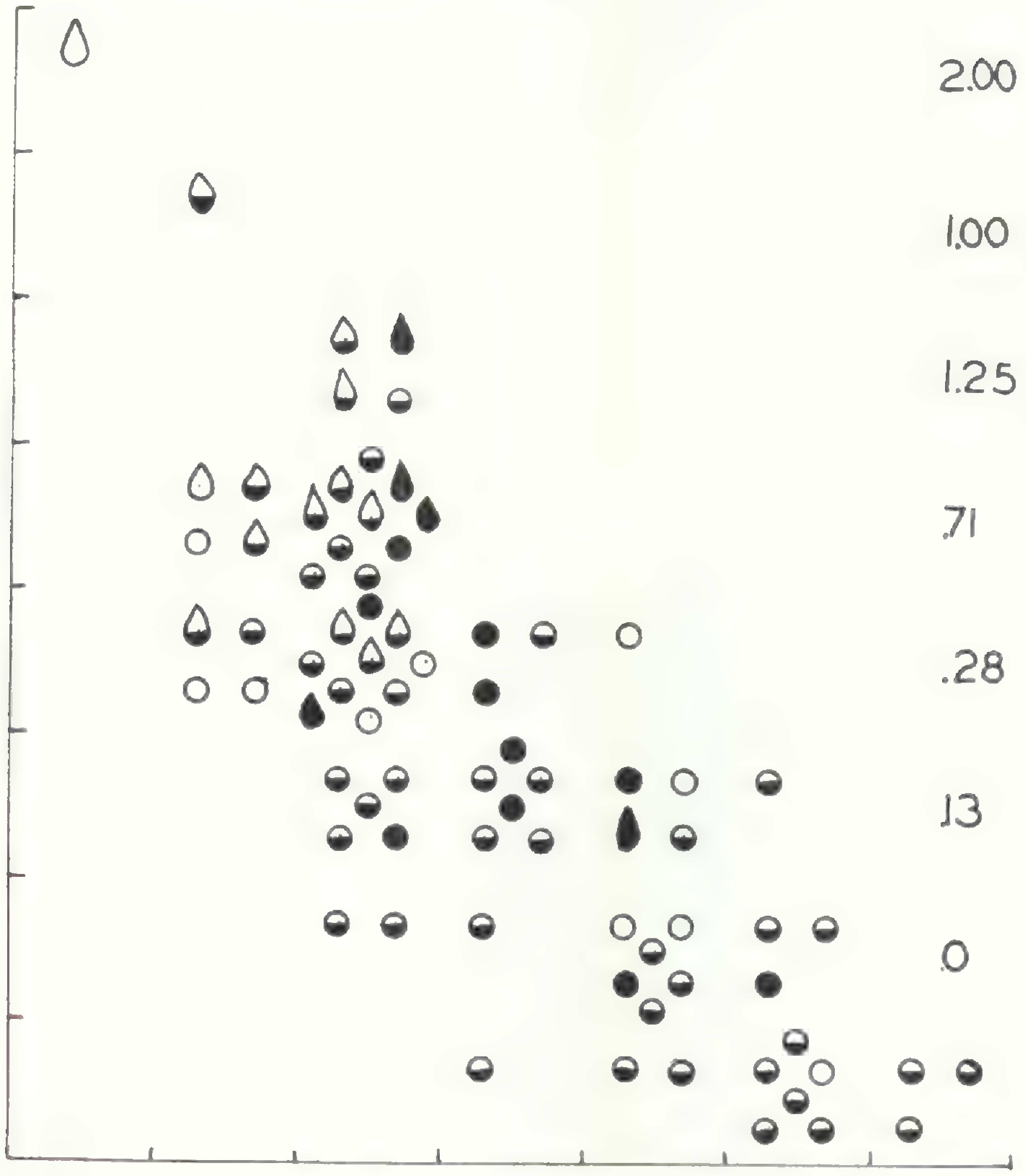


Fig. 3. Averages of all the collections made in Mexico on the same grid illustrated in fig. 2. Each circle represents the average of a single collection. At the right the average degree of pointing has been calculated for each row number (row numbers run from 22 at the top to 8 at the bottom; 2.00, strongly pointed; 1.00, slightly pointed; 0, no point).

all of Mexico are both popcorns. They grow in different regions and on very different-looking plants. When examined cytologically one has a maximum number of chromosome knobs, the other few or none. All they have in common is the ability to pop when heat is applied. Furthermore, one of them (the popcorn of Toluca) is so thoroughly amalgamated with the dent corns of that region that one cannot tell where dent corns leave off and popcorns begin (see below).

For the above reasons the maize of Mexico could not effectively be catalogued in these formal categories. It therefore became necessary to find a more useful classification. A fine preliminary report was published by the Russian Expedition (Kuleshov, '30) and with that as a basis it was possible from the beginning to work towards a natural system of classification for the maize of Mexico. (For a discussion of natural versus artificial classification see Anderson and Cutler, '42).

Methods

In beginning the work, collections of maize on the ear were received from H. C. Cutler, Ralph Beals, and Isabel Kelly. It was soon found that in a country with an ancient, indigenous civilization like Mexico, archaeologists, geographers, or even historians, were better collaborators than agronomists and botanists. *Maíz reventador* (Anderson, '44) is an example in point. Dr. Isabel Kelly collected numerous examples of this interesting variety from various localities in Jalisco and Zacatecas, though it was not represented in collections made by agronomists, either Mexican or American.

A variable and cross-pollinated crop such as maize cannot be effectively studied as individuals; more significant than any one plant or any one ear is the variation in the entire field or in the entire corncrib. To study the problem effectively it was therefore necessary to work out techniques for recording and analyzing variations in populations. Seed from samples from various parts of Mexico was grown and studied throughout the growing season. By trial and error, methods were worked out for recording the variation between plants, most particularly the differences between varieties from different parts of Mexico. Herbarium specimens of tassels and leaves were made and assembled with photographs of the original ears, diagrams of the internode patterns, samples of the kernels, and information about the chromosome knobs (in the few cases where that had been determined).

From these preliminary studies characters were chosen according to the following criteria:

1. The characters used should be objective and, if possible, capable of being measured or scored in an exact, objective fashion.
2. Their genetic basis should be broad (i. e., they must depend upon a large number of genes), so that their use will tend to bring genetically similar individuals together.
3. They should tend to characterize the varieties of any one area and to distinguish between the varieties of different areas.

The following characters were finally chosen:

Mid-ear width.—The width of the mature ear with its kernels attached, measured to the nearest millimeter with sliding metal calipers.

Shank diameter.—The diameter of the shank which supports the ear, measured immediately below the ear with sliding metal calipers. Unfortunately, in most Mexican maize this has to be estimated from such portions of the shank as adhere to the ear when it is picked.

Kernel width.—The width of a row of kernels, measured on the ear.

Kernel thickness.—Measured at right angles to the above. In practice the thickness of ten consecutive kernels was measured with the calipers and the result was divided by ten.

Tesselation.—The degree to which the kernels are tesselated (i. e., like tiles in a pavement). This is an important difference but needs to be broken down into such components as variation in kernel size and shape, 6- vs. 5- or 4-sided kernels, etc. In this material it was scored in three grades.

Denting of the kernel.—Scored as absent, slightly developed, strongly developed. A more objective way of scoring since worked out in North American material is: 1, kernel with no denting or capping of soft starch; 2, kernel markedly capped with soft starch but not dented; 3, kernel capped and lightly dented; 4, kernel capped and dented but surface of kernel not conspicuously wrinkled; 5, kernel capped, dented, and wrinkled.

Husk striation.—Longitudinal striations across the face of the kernels due to tight husks. Scored in three grades: 0, absent; 1, striations present but not making grooves across several consecutive kernels; 2, deep striations across the face of consecutive kernels.

Base compression.—Ears tapering slightly toward the base due primarily to tight husks. Scored in three grades.

Row number.—The number of rows, counted about a quarter of the way up the ear from the base, since many varieties have irregular rowing and/or increased row numbers immediately above the base, and many varieties drop out rows progressively between the middle of the ear and the apex.

Pointing of the kernel.—Scored in three grades.

Enlarged base.—Base of the ear, perceptibly wider than the rest. Scored in three grades.

Using these characters, variation in populations was studied from one field to another, largely in Jalisco, Michoacán, and the state of Mexico. In making the actual collections, 25 ears were selected at random from the field or corncrib under study. Except in a few instances, the corn in the crib represented the harvest from a single field. Obvious nubbins and ears on tillers were rejected; otherwise the selection was completely at random. In the corn cribs the micrometer was tossed into the crib and the ear nearest its point was selected for measuring. In fields the fourth plant in the row was taken, then the eighth in the next row, the twelfth in the next, and so on. Whenever possible Leica photographs were made of a portion of the collection. Due to the great scarcity of corn in Mexico, the minimum number of ears was retained as samples; it was usually easy to obtain permission to study the corn if the point was stressed that we did not care to buy it, but merely wanted to study it for an hour or so.

As soon as a few cornfields and corncribs had been sampled it was apparent that an efficient method of analyzing and summarizing the data was of first importance. The variation was too extreme and too manifold to carry in the mind or even to interpret from a series of averages and ranges of variation. What was needed was some method of turning the data on each cornfield into a general

over-all picture of that particular field. The graphical method used in Carter and Anderson's study of the maize of the Southwest ('45) had certain advantages, but the indices were somewhat subjective, the computations involved and there was no transparent relation between the spots on the comparison grid and the actual data. After considerable experimentation the method illustrated in fig. 2 was eventually adopted. It uses the two characters (row number and kernel width) which best fulfil all the criteria mentioned above. They are diagrammed at right angles to each other on Cartesian coordinates, the former being plotted on the vertical axis, the latter on the horizontal. The next two most important characters in studying the maize of Mexico are the denting of the kernel and the degree to which it is pointed. Both of these characters are easy to observe but difficult to score exactly in objective grades. Each was merely recorded as "absent", "weakly developed", or "strongly developed". They are, however, so important in characterizing the maize of different regions and of different varieties in Mexico that they were included in the diagram. This was done graphically as shown in fig. 2. The shape of each individual spot on the diagram shows whether that individual had unpointed, slightly pointed, or sharply pointed kernels. The degree of darkening of the spots shows the amount of denting on the kernels.

The method outlined above makes it possible to "see the woods in spite of the trees" and to compare one field of maize in its entirety with another field measured weeks, months, or even years later. In a variable and cross-pollinated organism such as maize, populations are more significant than individuals. Each individual combination of characters is more or less an accident; what is important is the general complexion of the whole population. If the diagrams in the appendix are examined it will be seen that each population is a more or less coherent whole and that the spots are not spattered at random over the diagram; for each sample they tend to cluster about a particular average. In some cases they are strongly aggregated, in others more dispersed, but even where they are widely scattered they are coherent. In other words, the field from which they came had a significant combination of gene frequencies and the diagram of 25 spots, all seen at once with a glance of the eye, is a fairly efficient reflection of that population. It is at least far more significant than isolated averages or frequency distributions of the four characters taken separately. As an example of how much can be analyzed and demonstrated by these diagrams, compare the two fields of *Maíz criollo* studied at Tlaquepaque with the two studied a few miles to the southwest at El Grullo and Autlán. At Tlaquepaque *Maíz chino* and similar varieties (with higher row numbers and more denting and pointing) are growing, and have been grown for at least a generation, in adjacent fields to the *Maíz criollo*. At Autlán and El Grullo these other varieties are not grown. It will be seen that, although all four diagrams present the same general picture, the spots in the Tlaquepaque diagrams show a tendency to drift up towards higher row numbers and narrower kernels and that in one of them is strong indication of mixture with a highly dented, more pointed-kernelled variety of higher row numbers (Appendix Nos. 1 & 2 vs. 15 & 20).

The results of the Mexican collections are summarized in Table I and the Appendix. In Table I the collections are assembled by communities and according to states, the latter arranged roughly from west to east and from north to south. Averages for ten of the characters are presented for each collection, together with the local name of the variety (as well as the name of the grower, or the location of the field in those cases where several collections in one locality make it necessary for precise identification).

Table I deals only with averages of populations. Records of individuals are presented in Appendix I as photographs of representative ears and diagrams of the type described above. It is apparent from even a casual inspection of Table I and the Appendix that the ten characters presented in the table are not distributed at random. On the whole, the characters tend to be associated in complexes, and these complexes show strong geographical trends. High row number, narrow kernels, and pointing of the kernel tend to go together as one complex which is most frequent in the state of Mexico and becomes increasingly less frequent as one goes westward. These facts are shown more precisely in fig. 3. In that figure each spot represents the average of a collection rather than individual ears. It will be seen that, as a whole, the collections run from narrow-kernelled and many-rowed varieties to wide-kernelled and few-rowed varieties. Furthermore, pointing of the kernel shows a very definite tendency to be associated with narrow kernels and many rows. This is demonstrated statistically at the right of fig. 3. Assigning grades of 2.0 for extreme pointing of the kernel, 1.0 for intermediate pointing, and 0.0 for no pointing, the averages have been calculated for the average (median) ears of each row number. It will be seen that the degree of pointing decreases regularly from 2.0 for 22-rowed ears to 0.0 for ears of 8 and 10 rows.

Table I also shows that this complex of high row number, narrow kernels, and pointed kernels follows a fairly definite trend from western Mexico to central Mexico. In the state of Jalisco, the bulk of the ears measured are 8- to 10-rowed, and population averages never go above 14 rows. While pointed kernels are found in certain varieties, they always represent less than half of the sample. In Michoacán, the next state to the east, there were no collections which averaged less than 12 rows and one which averaged as many as 18, and for some of the collections more than 50 per cent had pointed kernels. Still further east in the state of Mexico, there were no collections with average row numbers below 14, and half of the collections had a majority of pointed kernels.

The geographical trend in pointing and high row numbers is demonstrated more precisely in fig. 4, which presents collection averages for all those communities from which five or more collections had been made. The location of these four communities is shown in fig. 5. It will be seen that in the neighborhood of Autlán, in western Jalisco, all five collections had very similar averages in spite of the fact that the Autlán collections were actually made over a much wider area (San Gabriel to Autlán) than those in the other three communities. At S. P.

Collector	Locality	Number collected	Mid-ear width (cm.)	Shank diam. (cm.)	Kernel width (cm.)	Kernel thickness (cm.)	Denting	Husk striation	Base compression	Number of rows	Pointing	Enlarged base
	SONORA											
E. A.	Magdalena	1	4.3	1.9	1.0	.44	±	±	+	12		
E. A.	Corral	2	3.9	1.3	1.4	.43	±	±	±	9		
	SINALOA											
E. A.	Escuinapa	1	4.0	1.9	1.3	.42	0	+	+	10		
	NAYARIT											
E. A.	Acaponeta	4	3.5	1.5	1.1	.40	+	+	+	10		
E. A.	Tetitlán	2	4.5	2.5	1.3	.43	+	+	±	11		
	JALISCO											
E. A.	Autlán	25	4.1	1.5	1.5	.42	±	+	+	8	0	0
E. A.	El Grullo	25	4.2	1.6	1.5	.43	±	+	±	8	0	0
J.M.C.	El Chante	13	4.2	1.4	1.4	.41	±	+	±	10	0	0
I. K.	" "	2	3.8	1.1	1.1	.29	±	+	±	8	0	0
I. K.	" "	2	4.5	2.1	1.4	.40	0	±	±	10	0	0
I. K.	" "	2	4.4	1.3	.8	.38	±	±	±	16	0	0
I. K.	" "	2	3.9	1.2	1.2	.44	±	±	±	8	0	0
I. K.	" "	2	3.9	1.4	1.6	.36	0	±	±	10	0	0
I. K.	" "	2	2.7	.8	.6	.25	0	+	±	15	0	0
I. K.	" "	2	4.2	1.4	1.5	.43	±	±	±	8	0	0
I. K.	" "	2	5.3	1.5	1.0	.36	±	±	±	16	0	±
I. K.	" "	2	5.1	1.5	1.1	.36	+	±	0	14	0	±
J.M.C.	El Limón	10	3.0	1.1	.6	.32	0	+	+	14	0	0
E. A.	Chachahuatlán	25	3.2	1.0	.7	.35	0	+	+	14	0	0
E. A.	"	25	3.7	1.1	1.3	.35	±	+	±	8	0	0
E. A.	San Gabriel	25	3.8	1.4	1.4	.38	±	+	±	8	0	0
E. A.	Tuxcacuesco	25	3.7	1.3	1.3	.34	±	+	±	8	0	0
E. A.	Palmar	8	4.7	1.6	1.0	.35	+	±	±	14	0	0
I. K.	Union de Tula	1	4.8	1.2	1.0	.40	+	±	±	14	0	0
I. K.	Ayutla	2	4.6	1.2	1.0	.36	±	±	±	16	0	0
E. A.	Ameca	25	4.0	1.4	1.3	.40	±	±	±	10	0	0
E. A.	"	12	4.1	1.3	1.3	.46	0	±	±	10	0	0
E. A.	"	25	3.9	1.5	1.4	.44	0	+	+	8	0	0
E. A.	"	25	4.4	1.7	1.5	.42	+	±	±	10	0	0
E. A.	Tlajomulco	25	3.8	1.3	1.5	.42	±	+	0	8	0	0
E. A.	"	25	5.2	1.9	.8	.45	±	±	±	18	0	0
E. A.	Tlaquepaque	25	4.4	2.1	1.6	.48	±	+	0	8	0	0
E. A.	"	25	5.0	2.0	1.3	.47	±	+	0	12	0	0
E. A.	"	25	5.0	1.9	1.4	.50	±	±	0	12	0	0
E. A.	"	10	4.5	1.9	1.6	.49	±	±	±	8	0	0
E. A.	"	15	4.6	1.7	1.2	.40	+	+	0	12	0	0
E. A.	"	25	4.6	1.5	1.1	.41	±	±	±	12	±	0
E. A.	"	25	4.6	1.6	1.4	.41	+	+	0	12	±	0
E. A.	"	25	4.2	1.7	1.6	.47	±	±	±	8	0	0
E. A.	"	25	3.9	1.3	1.3	.40	±	+	±	10	0	0
E. A.	Tonolá	25	4.1	1.3	1.4	.39	±	+	±	8	0	0
E. A.	Tepatitlán	25	4.2	1.2	1.0	.35	+	±	0	14	0	0
E. A.	"	25	4.6	1.3	.9	.41	+	0	0	14	0	0
E. A.	"	25	3.6	1.0	1.2	.40	+	+	0	8	0	0
E. A.	Apango	5	3.9	1.4	1.1	.47	±	0	0	10	0	±
E. A.	Tapalpa	25	3.7	.9	1.0	.35	±	+	±	8	0	0
E. A.	"	25	3.5	.9	1.0	.39	±	0	0	12	0	±
E. A.	"	25	3.9	1.1	1.4	.37	+	+	0	10	0	0
E. A.	"	25	3.7	1.1	.9	.41	±	0	0	12	0	±
E. A.	"	25	3.1	.9	.9	.36	±	±	0	10	0	±

TABLE I

Collector	Locality	Number collected	Mid-ear width (cm.)	Shank diam. (cm.)	Kernel width (cm.)	Kernel thickness (cm.)	Denting	Husk striation	Base compression	Number of rows	Pointing	Enlarged base
	MICHOACÁN											
F.V.T.	Coalcomán area	16	3.9	1.0	.9	.32	±	+	0	10	0	0
F.V.T.	"	15	4.1	1.1	1.2	.37	±	+	±	10	0	0
F.V.T.	"	14	3.9	1.1	1.0	.33	±	±	±	14	0	0
E. A.	Apatzingán	25	4.6	1.4	1.5	.33	±	+	±	10	0	0
E. A.	"	25	4.2	1.3	1.3	.35	±	+	±	10	0	0
E. A.	Sahuayo	3	4.3	1.6	1.4	.44	±	±	±	10	0	0
E. A.	Jiquilpan	7	4.6	1.5	1.0	.41	+	0	0	14	0	0
E. A.	"	25	4.5	1.2	.8	.34	±	±	0	18	±	0
E. A.	"	25	4.7	1.4	1.1	.41	±	±	0	12	0	0
E. A.	"	25	3.1	.9	.8	.34	0	+	+	14	0	0
E. A.	"	25	4.8	1.5	1.2	.40	+	+	±	12	±	0
E. A.	"	25	4.5	1.6	1.3	.45	0	+	±	12	0	0
E. A.	Uruapan	25	4.2	1.2	1.1	.40	±	±	0	12	0	0
E. A.	"	25	4.4	1.7	1.4	.48	±	+	±	10	0	0
E. A.	San Lorenzo	25	4.4	1.4	1.1	.45	+	0	0	12	±	0
E. A.	Cherán	25	3.7	1.3	.8	.44	±	0	0	14	±	0
E. A.	"	25	4.4	1.3	1.0	.50	±	0	±	14	0	0
E. A.	"	25	4.8	1.5	.9	.43	±	0	0	16	±	±
E. A.	Patzcuaro	25	3.7	1.1	.9	.38	±	0	0	12	0	0
E. A.	"	25	4.4	1.3	.9	.42	±	±	0	14	0	±
E. A.	Lake Patzcuaro	25	4.2	1.4	.9	.41	±	0	0	14	0	0
E. A.	" "	25	4.5	1.4	1.1	.45	±	±	±	12	0	0
E.J.W.	Zitácuaro	25	3.6	.9	.8	.31	±	0	0	12	0	±
	STATE OF MEXICO											
E.J.W.	Toluca– km. 60	25	5.0	.8	1.2	.51	0	±	±	12	0	0
E.J.W.	" km. 57	25	3.4	.8	.4	.28	0	0	0	22	+	0
E.J.W.	" km. 17	25	4.6	1.0	.8	.39	±	0	0	16	0	0
E.J.W.	" km. 17	25	3.9	.9	.8	.37	0	0	0	14	0	0
E.J.W.	" km. 57	25	3.9	.8	.7	.37	±	0	0	16	±	0
E.J.W.	Chalco	25	4.9	.9	.9	.42	+	0	0	14	±	0
E.J.W.	Metepec	25	4.7	1.1	.8	.41	+	0	0	16	±	0
E. A.	Tepotzotlán	25	5.1	1.1	.8	.40	±	0	0	16	0	0
E. A.	Huehuetoca	25	4.4	.9	.8	.41	±	0	±	16	0	0
E. A.	Acupula	25	3.9	.7	.7	.37	0	±	±	16	0	0
E. A.	Huehuetoca	22	4.2	.8	.8	.42	±	±	±	14	0	0
	GUANAJUATO											
E. A.	León	25	4.6	1.4	.8	.35	±	0	0	16	0	0
E. A.	"	25	4.2	1.3	.9	.35	±	0	0	16	0	0
	MORÉLOS											
E. A.	Tlaltitzapán	25	5.3	1.1	.8	.32	±	±	0	16	+	0
E. A.	"	25	4.4	.8	1.1	.33	+	±	±	12	0	0
	PUEBLA											
R.H.B.	Otlatlán	25	4.5	.8	.8	.43	±	±	0	16	0	0

TABLE I *(Continued)*

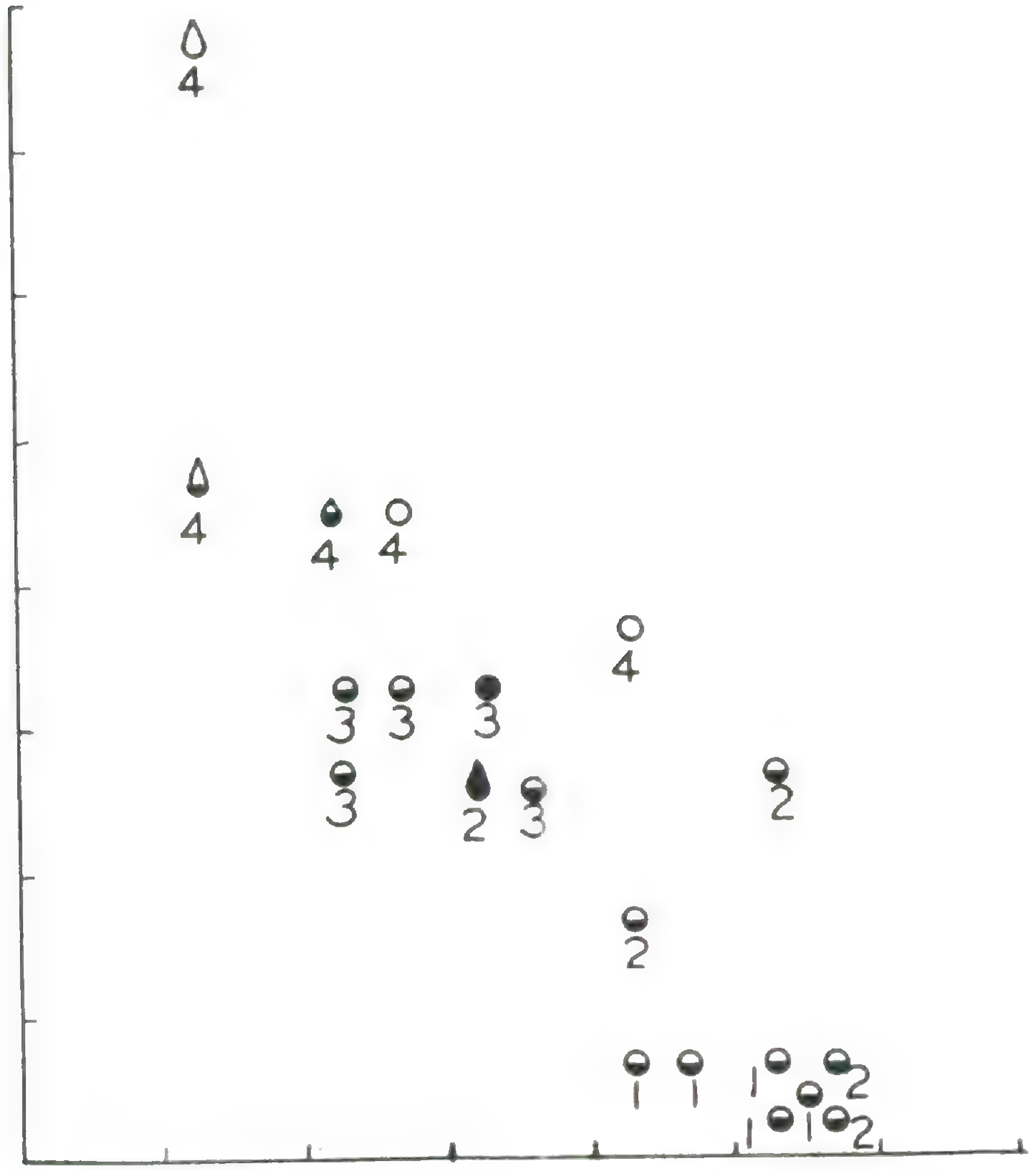


Fig. 4. Averages of 5 varieties of maize grown at each of the following towns: 1, Autlán in western Jalisco; 2, S.P. Tlaquepaque in central Jalisco; 3, Patzcuaro, Michoacán; 4, Toluca, Mexico. Each circle represents a collection of 25 ears averaged for row number, kernel width, denting of the kernel, and pointing of the kernel.

Tlaquepaque, a suburb of Guadalajara, some of the five collections are from adjacent fields and none is more than a mile distant from any of the others. These Tlaquepaque averages are particularly significant because although two of them are quite as extreme as those from Autlán, the other three are not, and one of the collections averages exactly the same as one from Patzcuaro, Michoacán. The Toluca collections present the other extreme. It will be noted that three of the five have a majority of pointed kernels and that all of them average 14 or more rows. Here again it should be pointed out that while these collections were made within a few miles of each other and some of them from adjacent fields, one of the collections is no more extreme on the average than are those from Patzcuaro. Figure 4 therefore demonstrates a fact which is borne out repeatedly in the detailed observations reported in the Appendix: The pointed-kernel, high row-number complex is not a direct effect of the environment. It is possible to grow

unpointed, few-kernelled varieties in central Mexico or many-rowed and pointed-kernelled ones in Jalisco. On the average, however, this is not done, and there is a strong and surprisingly regular gradient in these characters between Mexico City and western Jalisco.

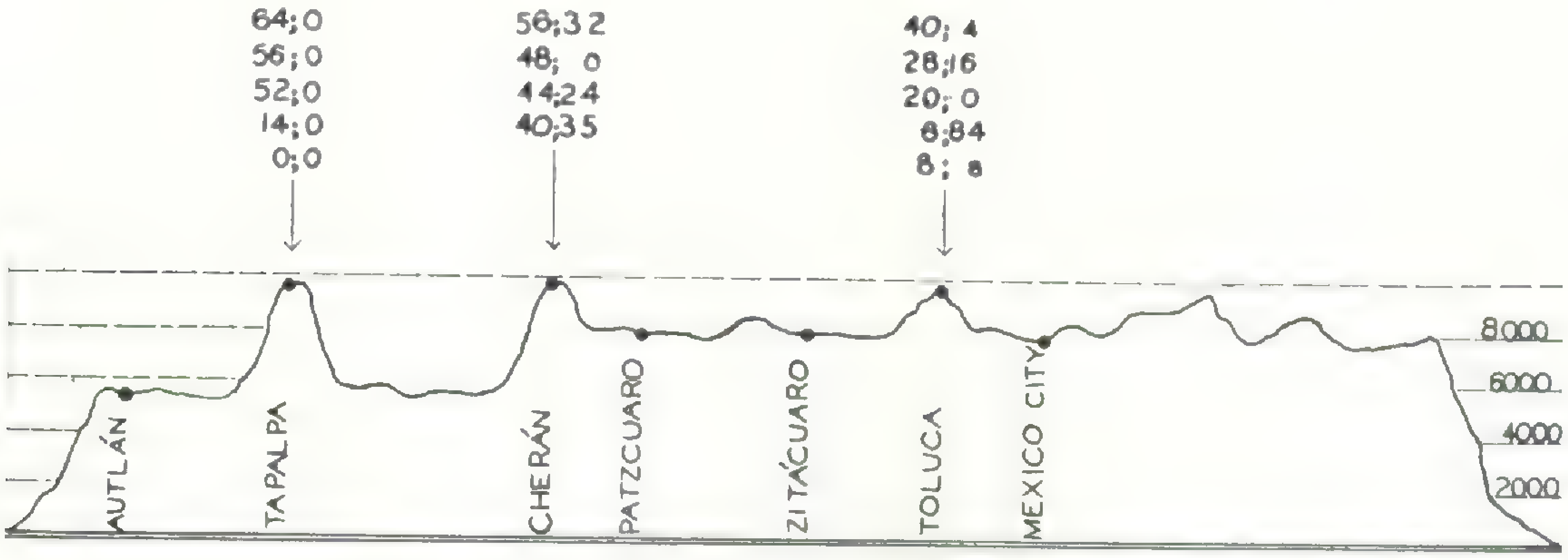


Fig. 5. Approximate cross-section from west to east through the area in central Mexico where most of these studies were made. Figures at the extreme right, elevation in feet above sea-level. For three mountain towns the per cent of each variety with ears enlarged at the base is shown above at left of colon, the per cent of pointed kernels at right of colon. It will be seen that percentages of enlarged bases increase from east to west and percentages of pointed kernels from west to east, on the average.

While the discussion has so far been limited to the evidence on kernel size and shape and on row number, many other characters are associated with this same gradient. The photographs of the Appendix show that the western Mexican extreme types have narrow, irregularly tapering ears which taper slightly towards the base as well as towards the tip. The varieties from central Mexico tend to have much shorter ears, many of which taper sharply to the apex and in an exact, almost mathematical fashion. From observations and collections in Mexico, as well as from progeny tests made at various points in the United States (Arcadia, Calif.; College Station, Tex.; St. Louis, Mo.; Johnston, Iowa; Blandy Farm, Va.), we know that there are correlated tendencies in the rest of the plant.

JALISCO	CENTRAL MEXICO
Long, narrow leaves with tough veins	Broad leaves with weak veins
More or less glabrous leaf sheaths	Very hairy leaf sheaths
Long, wiry tassel branches	Short tassel branches with densely arranged spikelets
Tassel branches, several to many	Tassel branches, several to few or none
Plant color, when conspicuously present, strongest along the veins and towards the base of the plant (strong R, weak b)	Plant color, when conspicuously present, strongest between the veins and above the ear shoot (strong B, weak r)
Strong root system	Shallow, weak root system

In other words, we have two extreme types of maize, one characteristic of western Mexico, the other of central Mexico. While the two extremes are so different as to be instantly recognized even as single individuals, they are connected by series of various intermediates. On the whole, the average intermediacy of a

population is proportional to its geographical position between the two different centers. Such geographically centered groups of correlated tendencies are characteristic of *Zea Mays*, and we have chosen to refer to them as "races" (Anderson and Cutler, '42), defining that term as "a group of related individuals with enough characteristics in common to permit their recognition as a group." The two races described above, while not the only major races in Mexico (see below), are by far the commonest. We have already designated the one from central Mexico as "Mexican Pyramidal" in reference to the short, and regularly tapering ears. It has also been recognized by Kuleshov ('30) in the report of the Russian expedition to Mexico as "Central Mexican Type." Kuleshov also referred to the other race described above as the "Narrow, long-leaved type." As a major race it probably extends all the way from the southwestern United States to the lowlands of South America. Until it has been more widely studied and more accurately measured it seems best to designate by name only that portion of it which has been accurately studied in western Mexico as "Mexican Narrow Ear."

The demonstration of a geographically oriented difference of this magnitude presents two questions: first, the theoretical one of how it originated and how it is maintained; second, the practical one of how to use it in making a natural classification (Anderson and Cutler, '42) of Mexican maize. A detailed discussion of the latter question will be deferred until some of the special varieties of Mexican maize have been described. For the first question there is fairly strong circumstantial evidence that the ultimate reason is historical; that these two races of corn were associated with different peoples and different cultures and that they once were even more distinct than they are now. Ultimately, of course, they must have had a common origin, but that problem is beyond the scope of this paper. However, even though there do seem to be historical reasons for the beginnings of these two races, their persistence must be due in part to differences in such factors as rainfall and altitude. The whole problem is much too complicated to be anything more than outlined here. Some of the most significant pieces of evidence are as follows:

1. The fact reported above, that varieties of very different positions on the gradient were sometimes grown in adjacent fields.

2. In a good part of Jalisco (see Appendix) the Mexican Narrow Ear varieties are referred to by a variety of names but are very commonly called "*maíz criollo*." *Criollo*, literally "Creole," used in this sense, means native or local, "old stuff belonging to this part of the country." In this same area intermediate varieties, however, are most commonly referred to as *maíz chino*. The word *chino*, literally "Chinese", is frequently used to indicate something foreign or peculiar. The common use of these two terms indicates that the 8-rowed varieties are the older sort and that the many-rowed, pointed-kernelled types are a later introduction. Though the latter are still much in the minority, their introduction is not a matter of just a few years. All the farmers with whom I talked assured me that "maíz chino" varieties were being raised in the locality when they were small boys (1890 to 1910).

3. There are various theoretical reasons for believing that when native varieties of popcorn are present they may represent the most primitive types of maize in that area. The native popcorn of western Mexico, *maíz reventador*, is like Mexican Narrow Ear varieties in everything but kernel size and its slightly higher row number. It has 12 to 14 rows but never the high row numbers of central Mexico. The native popcorn of the Mexico City-Toluca region, however, is vastly different and a typical "Mexican Pyramidal" variety. It is exactly like the small white dents of that region in every character except kernel size and texture. There is archaeological evidence to indicate that these two popcorns have been in their two respective areas for a considerable time. As has already been reported, Dr. Isabel Kelly has found charred remains of a corn at least very similar to *maíz reventador* in two excavations in western Mexico (Anderson, '44a). In Gamio's excavations at Teotihuacan (roughly from 1200 A. D.), just north of Mexico City, he found large masses of carbonized corn cobs and kernels which are on display in the local museum and which I was allowed to examine through the courtesy of the custodian. Measurements for the material are as follows:

Row number: 18, 18, 20
Kernel width in mm.: 4–7
Kernel thickness in mm.: 4
Kernel length in mm.: 8

Allowing for a little shrinkage in carbonizing they are exactly the same size and have the same shapes and row numbers as the popcorns and small pop-dents which are now being grown in the same region.

4. Among the most conservative and primitive Indian tribes of western Mexico are the Huichol who live in the steep-sided cañon region of Nayarit and adjacent states. The ethnologist Carl Lumholtz visited them in 1890 and collected a fine series of the varieties of maize used in their ceremonies, which are now in the American Museum of Natural History in New York. Three of the varieties are identical with those still being grown in the neighborhood of Autlán, the other differs only in its color (stippled aleurone). All are typical "Mexican Narrow Ear." Through the courtesy of the department of Archaeology I was able to measure these and the results are presented in fig. 6.

5. The differences between these races are inherent. When grown at various experimental fields in this country, these two extreme types were quite as conspicuously different as they are in Mexico. Both forms were somewhat abnormal when grown in the north, though mostly in different ways. The Mexican Pyramidal varieties often developed long ear branches. The Mexican Narrow Ear extremes have the capacity to develop tillers equalling the main stalk. In western Mexico these varieties are usually planted in the summer on account of the spring dry season, and only a few tillers develop. (In S. P. Tlaquepaque, Jalisco, I made a small experimental planting in the early spring and ascertained that Mexican

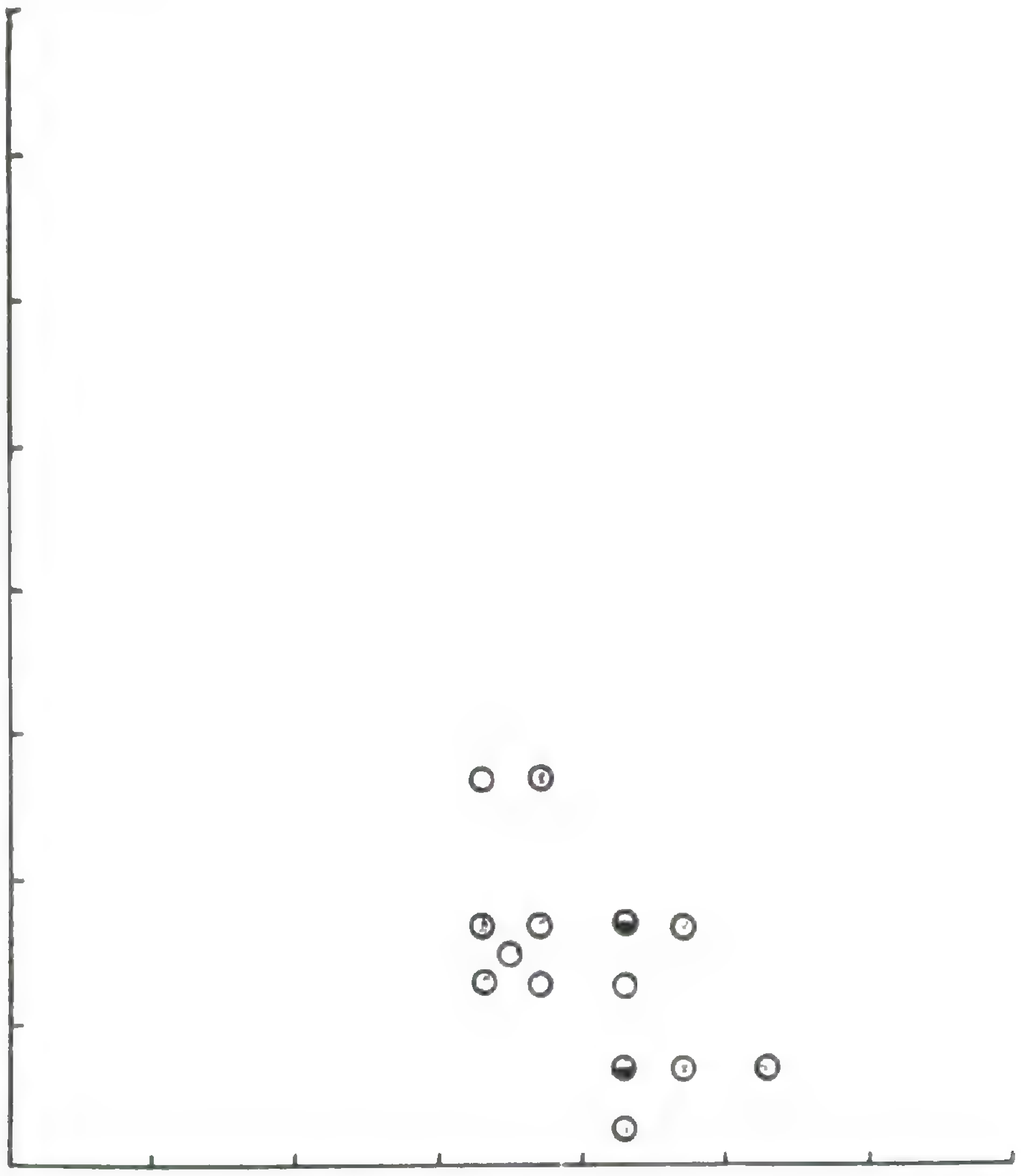


Fig. 6. Ceremonial corns collected among the Huichol Indians by Carl Lumholtz and now in the American Museum of Natural History in New York. Each circle represents a single ear (collection nos. 1889, 1897, and 1890). Scale of grid as in fig. 2.

Narrow Ear varieties would also develop many tillers if planted there at that season, though Mexican Pyramidal varieties did not tiller.) When planted in the north in the springtime, these western Jaliscan varieties tiller profusely. As a result of these two tendencies, these two races of Mexican corn look even more extreme when grown in the United States than they do in Mexico.

6. All the above evidence shows that the two extreme types have been in their areas for a long time and suggests that anciently the boundary between the two may have been sharper than it is to-day. There is some evidence, however, to show that ecological factors also play a role in keeping up the partial barrier between the two sorts. Between Autlán and Mexico City there is a general change in altitude and in climate pattern. The differences in amount and distribution of rainfall are probably a controlling factor. All of the large collections of corn which I measured in the plain and valleys around Autlán (Autlán,

Chachahuatlan, Tuxcacuesco, San Gabriel, El Grullo) were either specialty crops like *maíz dulce* (see below) or were typical Mexican Narrow Ear varieties. This is a region in which the scarcity of water has been a problem for a long time (Kelly, '45). Near by, in small clearings in the forested hills between Tuxcacuesco and El Limon, however, I made small collections of much superior, large-cobbed, many-rowed, deeply dented varieties (see Palmar in Table I and the Appendix). I was told locally that these varieties were grown back in the hills because there was more water available there.

Mountain Yellow

While the maize of the Mexican plateaus is varied as compared with that of the American Corn Belt, the variation becomes even greater as one ascends the mountains which rise above the plateaus. This maize of the mountains is so extremely variable from plant to plant and from field to field that it is difficult to discuss its general over-all tendencies. Collections were made in three such mountain regions and at about the same elevation in all three cases (fig. 5): (1) Toluca, just to the west of Mexico City; (2) Cherán in Michoacán; and (3) Tapalpa in Jalisco, on the northern flank of the great Volcán de Colima. In all three of these regions the corn was smaller-eared and shorter-statured than on the plateaus below. It was also more variable in pericarp color and with more red in the pericarp on the average. The percentages of pointed kernels were also somewhat higher. In the mountains one also finds a character which is very common in Guatemala though rare in most of Mexico: ears which are conspicuously larger at the base, giving them the over-all appearance of slightly tapering cylinders emerging from flattened spheres. Such ears are seldom seen on the plateaus. Around Guadalajara, Jalisco, for instance, at a general altitude of 5200–5400 feet there were twelve collections made. In eight of these there was not a single ear with a perceptibly enlarged basal region; there were two collections with 4 per cent and two with 16 per cent. In the mountains of Michoacán nine collections were made at elevations over 7000 feet with percentages from 32 to 80.

In spite of the variability of mountain corn and in spite of a general tendency for increased basal enlargement with altitude there is a very perceptible geographical trend in mountain maize from east to west. In central Mexico the mountain corns tend to be white, many-rowed, with pointed kernels. As one goes westward at equivalent elevations there is an increasingly great tendency for them to be yellow, few-rowed, and with an ear perceptibly enlarged at the base. This conclusion is supported not only by the detailed collections from the three areas referred to above but by much more maize which was seen but not measured, and by the large collections made by Beals in Michoacán and by Kelly in Jalisco. For Tapalpa, Cherán, and Toluca the measured collections yield the following information:

Locality	State	Per cent enlarged base	Per cent pointed	Prevailing color
Toluca	Mexico	40	4	Bright yellow
		28	16	Light yellow
		20	0	White
		8	84	White
		8	8	White-yellow
Cherán	Michoacán	56	32	Light yellow
		48	0	White
		44	24	Light yellow
		40	32	Light yellow
Tapalpa	Jalisco	64	0	Yellow
		56	0	Yellow
		52	0	White
		4	0	Light yellow
		0	0	Light yellow

TABLE II

This tendency to yellow-endospermed varieties with fewer rows and enlarged bases seems the more significant because this combination of characters is met with in Guatemala to an exaggerated degree. It seems likely that, in addition to the Mexican Narrow Ear and Mexican Pyramidal complexes of characters, there is a third complex much less strongly represented, which we may call "Mountain Yellow." Much more study will be required to demonstrate its presence and to analyze its historical and biological basis. From the facts at hand it seems to be connected with Guatemala in some way and in central Mexico to have spread from the west eastwards, at high elevations.

Varieties for Special Purposes

"Elote" Varieties (see pl. 7).—

In Mexico, as in the United States, much corn is used before it is fully ripe, either as corn-on-the-cob *(elotes)* or in various special dishes. Though native sweet corns are widely distributed in western Mexico (Kelly and Anderson, '43), they are not used for green corn since they are too gummy. Most of the common field corns are so used but there is also a widespread tendency to grow special varieties with colored (blue or red) aleurone for that purpose. This tendency is more clearly marked, and the varieties are more clearly differentiated morphologically from other local varieties, among the Tarascans of Michoacán (as has been reported by Beals, '46 [in press]). The *elote* varieties of this region are dark blue or black and are strikingly different in kernel size and ear shape from the field varieties there. They are not grown in the regular corn fields *(milpas)* but in small fenced enclosures close to the houses. In Jalisco the differentiation of *elote* varieties is not so extreme but it exists. In the town of S. P. Tlaquepaque, for instance, field corns are mostly white or yellow and are planted quite thickly in heavily ridged rows with an underplanting of squashes. The *elote* varieties are red (less frequently blue) and are ordinarily planted widely spaced in fields of peanuts. They are early-maturing and are harvested before the regular field varieties. In Tapalpa, Jalisco, on the northern flank of the great volcano of

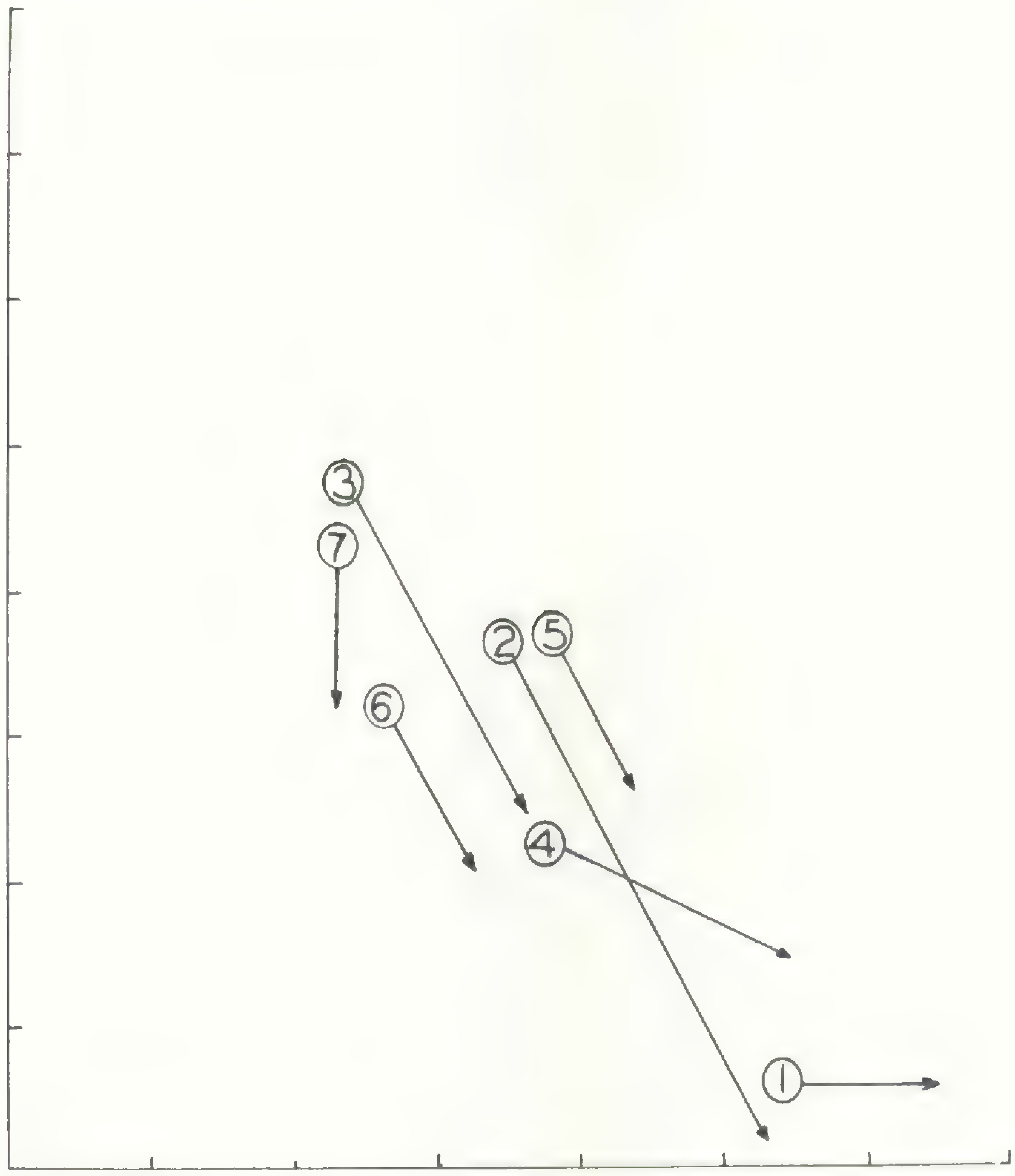


Fig. 7. Relation between the blue or purple "elote" corns and the common varieties of maize grown in seven different communities in various parts of Mexico. Grid for row number and kernel width as in fig. 2. In each case the circle with a number shows the average row number and kernel width of a common variety of maize growing near the "elote" variety. The position of the arrow shows the average row number and kernel width of the "elote" variety at that locality. Number 1, Tlajomulco (near Guadalajara, Jalisco); 2, S. P. Tlaquepaque, Jalisco; 3, Tlaltizapán, Morélos; 4, Uruapan, Michoacán; 5, Jiquilpan, Michoacán; 6, Patzcuaro, Michoacán; 7, Huehuetoca, Mexico. Number 2, for instance, indicates that the "elote" variety at Tlaquepaque had an average row number of 8 and an average kernel width of 14–15 mm. while the white corn grown by the same family had an average row number of 14 and an average kernel width of 10–11 mm. Further discussion in the text.

Colima, I was at first told that no special varieties were used for *elotes*. Description of the blue and red corns I had seen elsewhere brought out the fact that they were also grown in Tapalpa but on a very small scale. The local corn merchant himself showed me seed ears for his next year's crop of *elote* corn hanging in his own patio, though no stocks of this variety were stored in his big commercial granary.

Where they were grown these blue and red varieties were reported to be superior for green corn-on-the-cob, and for the production of various other maize foods such as *pinole* (Kelly and Anderson, '43). Inquiry as to why they were

grown usually brought out that they were sweeter or of a smoother consistency *("son mas suave")*, and sometimes that they were earlier to ripen.

In the Tarascan country (Cherán and other villages near the new volcano) the *elote* varieties were so strikingly different morphologically from the other corn of that region that it seems as if they must have been introduced at another time than the field varieties or from a different region. In other parts of Mexico the difference is not so striking but there is the same general tendency for these varieties to have broader kernels and fewer rows than the ordinary field varieties. It would be difficult to be certain on this point from mere inspection, due to the great variability of Mexican maize. However, the method of recording the variation in an entire corn field, illustrated in fig. 2, allows us to make exact comparisons between *elote* varieties and field corns from the same localities. Figure 7 shows comparisons of the averages of the blue or red *elote* varieties in seven different communities with the white or yellow field varieties of the same communities. In cases where more than one field variety had been examined the one chosen was from the nearest field or was one grown by the same farmer. It will be seen that in each of the seven cases the *elote* varieties are more like Mexican Narrow Ear varieties. They are either fewer-rowed or broader-seeded or both.

To summarize: In Mexico special varieties of maize with colored endosperms are grown for use as green corn. These varieties are generally broader-kernelled and have fewer rows than the common varieties with which they are grown. There is a tendency to grow them in special plots. All these facts suggest that after maize growing was already established, there was the introduction of Mexican Narrow Ear varieties with colored aleurone for use as green corn. There is no evidence that this introduction was a recent matter and there are some indications that it may have been pre-Columbian. The habit is widespread; it is highly developed in little out-of-the-way towns with conservative habits, and similar varieties are used by the Huichol Indians in their ceremonies. This last fact is particularly significant since the Huichol are a conservative group living in a region isolated by high mountains and deep cañons. The collections of ceremonial corns described above were still being used when Lumholtz collected them, and they probably represent varieties which are very ancient in that part of Mexico. Two of the varieties collected by him, one a blue and one a red, are so similar to the *elote* varieties now being grown in Jalisco that they could not be separated out if the ears were mingled. Since the Huichol are in western Mexico and since the general trend in each locality is for the *elote* varieties to be more like extreme examples of Mexican Narrow Ear, it seems highly probable that these *elote* corns spread across Mexico long ago from the west and that they have since become more or less contaminated in each locality by the common maize of each region.

Cacahuazintle.—

One of the most distinctive varieties grown in Mexico is the kind called *Cacahuazintle* (literally, "ear of corn with a tough skin") in the region around

Mexico City. We have two collections, one from the valley of Toluca and another from the little Nahua-speaking village of Otlatlán in Puebla. In both ear and plant characteristics this variety is enough different from the other varieties of this region to be an obvious introduction. On the other hand, its Nahua name and its presence in this remote village suggest that its introduction is not a recent matter (see fig. 1, lower right two ears, and Appendix No. 71).

Cacahuazintle kernels are filled almost completely with soft starch, though some of the ears from Toluca and a majority of those from Otlatlán show indications of a more or less well-developed dent. Their kernels are large, nearly as thick as they are wide, and tend to be well distributed over the apex of the ear. I did not see the plants but was told in Toluca that they are of a different color from the common corn of that region and that they are taller and later to mature.

The ears of *Cacahuazintle* are so similar as to be almost identical with the Guatemalan variety known there as "Salpor", which in turn differs but slightly from some of the large-kernelled white flour corns of highland South America. *Cacahuazintle* is reported to be used commercially in the neighborhood of Mexico City for the manufacture of starch. In that region it is commonly prepared by swelling it in rapidly boiling water, and when so treated is considered as a kind of popcorn. While I never saw any specimens of it in western Mexico, its reputation had preceded it there, and I was several times told about the wonderful big popcorn of Mexico City which was cooked in boiling water.

The facts reported above are all in harmony with the hypothesis that *Cacahuazintle* spread into central Mexico from Guatemala or southern Mexico in pre-Columbian times.

The maize varieties of several Spanish-American communities in the American Southwest bear a suspicious resemblance to *Cacahuazintle* in their large white kernels. This is particularly true of some obviously mixed commercial varieties from Lower California and in the "*maíz del pais*", which has been previously described (Anderson, '44b), from San Luis Obispo, California. It seems quite possible that a variety with kernels of this size and quality might have been widely scattered in colonial as well as pre-colonial times. A careful comparative study of *Cacahuazintle* and similar varieties should give us a more precise understanding of these relationships.

Maíz dulce (see pl. 8).—

These distinctive varieties, carrying the recessive gene for sweet, have been the subject of a special monograph (Kelly and Anderson, '43). It remains to point out here that although collections made in Jalisco show certain general resemblances to the other maize of that region, they also show a number of differences. They have more rows (the rowing is more irregular), the ears are shorter and are much more smoothly rounded at the butt. The kernels are smaller and the red color of the pericarp (due to various crown alleles of P) is not common in that region. A detailed discussion of these differences must be postponed until

such a time as the origin and dispersal of sweet corn in the New World is considered in detail. To clarify this survey of Mexican maize the following summary of the evidence may be inserted parenthetically. Recessive genes for sweet are known to have appeared as mutations at various times and places, and may well have occurred repeatedly in various parts of North and South America. The origin of the use of these distinctive mutations, however, follows a fairly simple pattern. It apparently took place in pre-Columbian South America as a source of sugar, before the introduction of sugar cane, sorghum, etc. Like the varieties of the region where they originated these primitive sweet varieties had "hand-grenade" ears, crowned pericarp, and many and irregular rows. They spread northward, gradually mixing with other kinds of maize, but protected somewhat by being recessives so that when careful seed selection was practiced, outcrossed kernels were discarded. In combination with the characteristics of the maize in which they originated, these sweet mutants were too gummy to be eaten as green corn. As the sweet varieties were gradually modified in their spread northward they eventually became watery enough to use as green corn, and were developed in this way among the North American Indians. The post-Columbian introduction of sugar cane reduced their importance as a sugar source and only in a few conservative areas (as in small towns in Jalisco or among the Hopi) have they been retained for their original purpose.

Popcorns.—

In addition to *cacahuazintle* (which is scarcely a popcorn by American standards) there are at least two popcorns in Mexico. They are grown in different areas and are associated with different races of maize. *Maíz reventador* (pl. 9), of the west of Mexico, is similar to Mexican Narrow Ear varieties in everything but kernel size and row number and is probably one of the ancestral sources of those varieties. It has been the subject of a special monograph (Anderson, '44a). The popcorns of Toluca are typical Mexican Pyramidal maize and are thoroughly amalgamated with the small white dents of that region (pl. 5). No natural boundary can be laid down between these small white, many-rowed dents and the small rice popcorns of the same regions. They are identical in plant type and they fade into each other from plant to plant and from field to field. A little denting is to be found in every crib of popcorn which I have examined, and hard, flinty, pointed kernels are a commonplace in the white dent corns of that region. Archaeologically these Toluca popcorns and pop-dents are interesting because they are identical in size and row number with the corn excavated by Gamio at the ancient pyramids constructed by the Toltecs in the valley of Mexico. Agronomically they are noteworthy as the probable source of the so-called Jap Hull-less popcorns to which they bear an extremely close resemblance in plant, kernel, and ear characteristics.

Discussion

There remains the discussion of certain problems in the light of this general survey of maize in central Mexico: (1) the practical question of how to describe and catalogue Mexican varieties of maize, (2) the origin of denting, (3) the genetics of multiple factor characters in modern maize.

(1) *The classification of Mexican maize.*—The question of artificial vs. natural systems of classification was discussed *in extenso* in the first paper of this series (Anderson and Cutler, '42) and need not be repeated here. It was pointed out there that the system usually followed (Sturtevant's) was almost purely artificial and that it was not very practical outside of the United States. A wholly natural system, however, if indeed it ever can be attained, is a goal to work towards rather than something which can be immediately set up in its complete form. We have therefore studiously avoided the use of Latin names and descriptions which would give our tentative and fragmentary attempts a more official status than they deserve. In the survey reported above we have attempted to demonstrate that the characters of Mexican maize are not distributed at random but are loosely associated in a few great complexes with marked geographical and altitudinal trends. The groups of varieties bearing these complexes of characters we have termed races, and while some fields show strong evidence of only one race, much of the maize of Mexico shows two or more in a single field.

For the practical business of describing and cataloguing Mexican varieties it would seem quite feasible to describe the typical "nucleus of common features" which typifies each race and then to indicate the preponderance of the various races in any one variety. When more than one race is evident in a variety, they should be cited in the order of their predominance. Races evident only upon close inspection should be cited within brackets. The varieties grown around Guadalajara, for instance, would mostly fall into Mexican Narrow Ear or Mexican Narrow Ear (Mexican Pyramidal). The varieties grown in Tapalpa would be classified as Mountain Yellow, Mountain Yellow (Mexican Narrow Ear), and Mountain Yellow (Mexican Pyramidal and Mexican Narrow Ear). When all the main races of maize in Mexico have been recognized and described it should then be possible to work out exact statistical techniques for assigning numerical values to the various racial components of any particular variety.

It is still premature to do anything more than suggest such a system. In addition to the races described above there are certainly others in Mexico. The varieties of the Tarahumare Indians need intensive study, so do the varieties of Oaxaca, Chiapas, and the east coast. Through the kindness of the Dirección de Agricultura y Fomentá and of Dr. E. J. Wellhausen of the Rockefeller Foundation I was able to measure and photograph collections from other parts of Mexico. From these collections it is clear that the highly derived varieties of the Pueblo Indians have spread down to northern Chihuahua and that some of the maize of the Mexican state of Chiapas is similar to that of

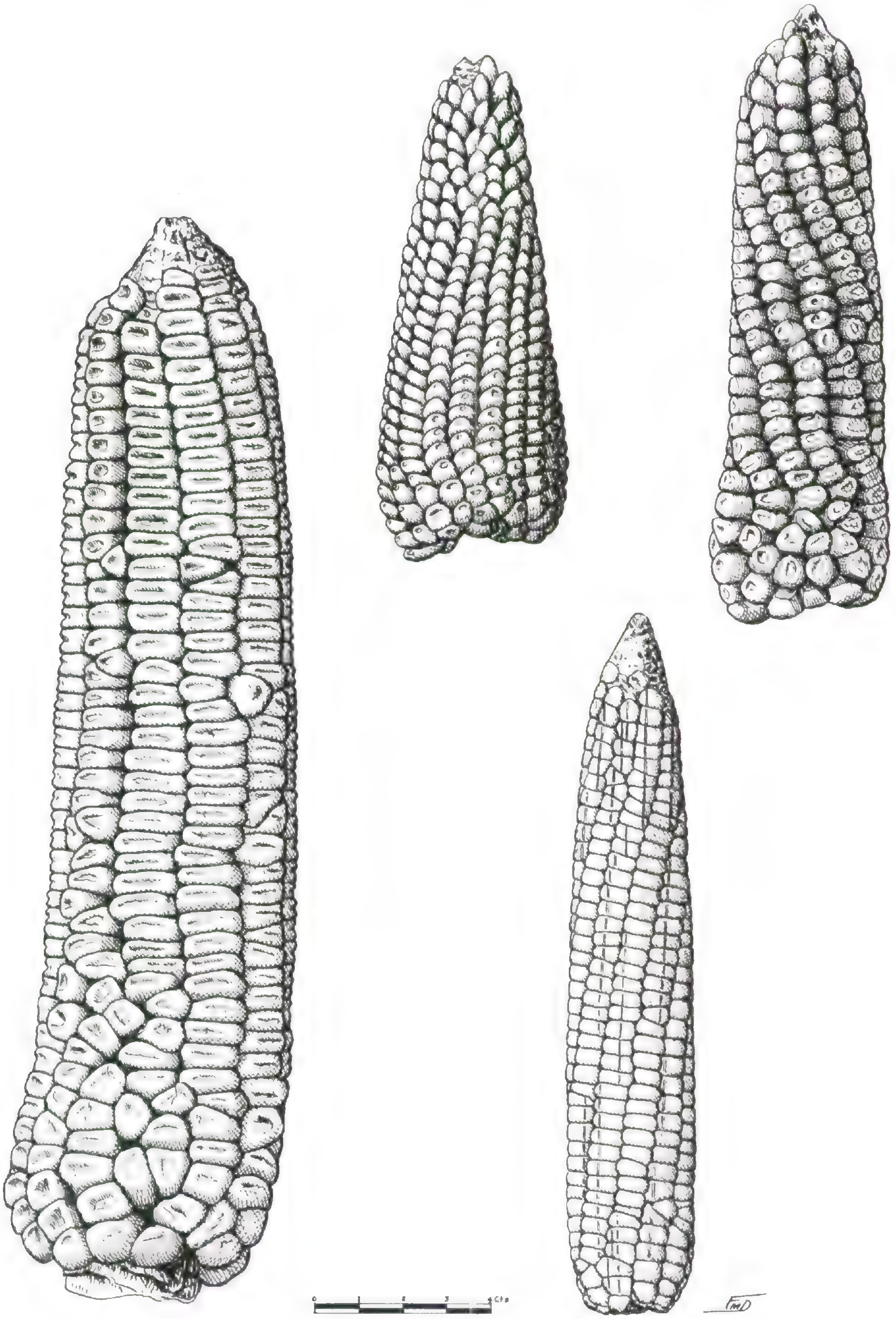


Fig. 8. Drawings showing racial extremes among the collections made in Mexico: upper right, an ear of "Mountain Yellow" from Tapalpa, Jalisco; upper center, "Mexican Pyramidal" pop-dent from Toluca; left, an ear from a field of *maiz ancho* at S. P. Tlaquepaque, Jalisco, which shows more indication of "Guatemalan Big Grain" than any other in that region. Collections from Chiapas showed a more enlarged base to the ear and a more regularly cylindrical upper portion. Lower right, *maíz chapolote* from Sinaloa, representing an even more extreme type than "Mexican Narrow Ear." Scale in cm.

adjacent Guatemala. The large shanks, enlarged base to the ear, and long ears of these varieties from Chiapas are a complex of characters found in somewhat diluted form in Mountain Yellow but of particular importance in Guatemala. Just as Mexican Pyramidal maize is tied up with the history of the Aztecs and their predecessors in the Valley of Mexico, so this Guatemalan complex is associated with the Mayas and their forerunners. As a convenience to students of Central American maize, the characteristics of these Mexican races are listed below in condensed form:

Mexican Pyramidal.—Found in purest form in the Mexico City-Toluca neighborhood. Plants short, highly colored, color characteristically interveinal (strong B, weak r). Plants with shallow root systems, leaves broad, with hairy sheaths. Tassels with few branches or none, condensation index very high. Ears short, tapering regularly, row number high to very high. Kernels more or less pointed, more or less dented. Endosperm prevailingly white, and yellow, usually pale, even when present (pl. 4).

Mexican Narrow Ear.—Apparently the common race of western Mexico, though variously modified locally by introduction and selection. The prevailing type in Jalisco up to 7,000 feet. Allied to such ancient varieties as *maíz reventador.* Plants tall, slender, from slightly to highly colored, color veinal (strong R, weak b). Stalks stiff, sheaths only slightly hairy. Tassel branches several to many, long and wiry, condensation index low. Ears narrow with small cob, long, irregularly long-tapered, compressed at butt and with long striation lines from tight husks. Row number characteristically 8 to 14. Kernels unpointed, slightly dented, if at all. Endosperm prevailingly white (all those tested have been *ccrr* [pl. 2]).

Mountain Yellow.—At high elevations. Found in purest form on the tableland north of the Volcán de Colima. From thence eastward, becoming progressively more mixed with Mexican Pyramidal. Endosperm bright yellow. Ears and kernels small, somewhat compressed. Ears distinctly enlarged at the base and with irregular rowing there (pl. 5).

Guatemalan Big Grain.—A characteristic Guatemalan type. Ears long with large, strong cob, firmly held on a big shank. Lower end of ear distinctly enlarged, upper part sub-cylindrical. In Mexico known in a pure form only from the State of Chiapas.

(2) *The origin of denting.*—The genetics of denting in maize has scarcely advanced beyond the point where it was left by the pioneer investigations of Hayes and East ('15). Whatever the origin of denting, its genetical background seems to be complex. The survey reported above demonstrates that in Mexico, denting reaches its most extreme development neither in the Mexican Pyramidal varieties nor in the Mexican Narrow Ear, but in kinds like *maíz chino,* which seems to be a mixture of both races. This assertion is no more than suggested by the figures of Table I, but in Mexico it is a matter of common observation that in traveling from western Jalisco to Mexico City one passes out of a region of undented or slightly dented Mexican Narrow Ear varieties into the variable but strongly dented varieties of the Bajio and eventually reaches another region of less denting, the Mexican Pyramidal center of pointed popcorns and pointed "subdents." This would suggest that denting is in some way associated with race mixture in maize. These results are in conformity with Jones' experimental evidence ('24). He crossed a pointed popcorn with a flour corn and obtained dented kernels in the second generation. It may be that in some manner not yet clear the dent corns of Mexico are hybrid derivatives of the pointed popcorns and the crescent-seeded flint and flour corns.

(3) *The genetics of multiple factor characters in maize.*—The survey reported above demonstrates that certain complexes of characters tend to be found

together in Mexican maize. Since all of the dent corns of the United States are derived from Mexican varieties, at least in part, we may expect to find some of these complexes still playing an important role in the maize of the United States Corn Belt. One who has studied character combinations in the cornfields and corn cribs of Mexico cannot walk through a modern breeding field in the United States without noticing the resemblances of certain widely grown inbred varieties to Mexican corn. The two inbreds, K43 and Illinois HY, for example, present combinations of characters that, while very different from the open-pollinated varieties from which they are derived, are almost identical with certain Mexican combinations. It has been shown from theoretical considerations (Anderson, '39), as well as by experimental test, that the total effects of specific and racial coherence are incredibly strong. If this be true in maize, we might therefore expect that our American dent corns would still be characterized by whole blocks of genes which tend to stay together because they came in together in Mexican white dents. If these complexes of genes still tend to be found together, on the average in American corn, then to understand and to analyze the genetics of multiple-factor characters in maize we shall have to pay attention to certain combinations of characters. In other words, the genetics of multiple-factor characters in maize has a good deal in common with *Oenothera* genetics. The complexes in *Zea* are probably much less loosely knit than they are in *Oenothera* and will therefore be more difficult to recognize and to locate in the germ-plasm. On the other hand, *Zea* is more completely analyzed genetically than any other plant. With concerted action it should eventually be possible to find which chromosomes carry the distinctive character combinations of Mexican Narrow Ear and Mexican Pyramidal, and then to use that information in maize breeding.

Summary

1. The great variability of Mexican maize is described. It varies from plant to plant in the same field, from field to field in the same locality, and from region to region. For the first two of these categories the variation is like that in the United States but greater in magnitude; the regional variation is beyond anything encountered in the United States.

2. The customary pigeon-holes of maize agronomists (dent corns, popcorns, flint corns, etc.) are shown to be inefficient and misleading in Mexico.

3. It is argued that in classifying a variable, cross-pollinated crop like maize the population is a more significant unit than the individual.

4. A method of measuring and describing maize populations (fields) is developed and applied to the collections made in Mexico.

5. By means of this method the association and geographical distribution of high row number with narrow, pointed kernels is analyzed.

6. Other characters are shown to be associated with these trends in row number and shape of kernels. High row number, pointed kernels, wide, hairy leaves, condensed tassels, constitute a complex characterizing the Mexican Pyramidal race.

It is centered in the state of Mexico. Low row number, long, irregularly tapering ears, wide kernels, narrow leaves, long, wiry tassel branches, form a complex characterizing the Mexican Narrow Ear race of western Mexico.

7. The available evidence suggests that the ultimate reasons for these different races are largely historical but that their persistence in modern times is in part due to their adaptation to different areas.

8. Evidence is presented for the existence of a third race, Mountain Yellow. It resembles Guatemalan maize, is restricted to high altitudes, and from Jalisco eastwards to Toluca becomes increasingly mixed with Mexican Pyramidal.

9. Several varieties grown for special purposes are described in detail:

A: Varieties with colored aleurone used as green corn. They apparently spread from western Mexico in ancient times and have become more or less mixed with the common varieties of each region.

B: A large-kernelled flour corn known as "Cacahuazintle" apparently derived from the "Salpor" variety of Guatemala.

C: *Maíz dulce,* whose significance in the history of American sweet corns is briefly indicated.

D: The ancient popcorn of the west coast, *maíz reventador,* and the very different rice popcorns of the state of Mexico.

10. Three general problems are discussed in the light of the above survey: the classification of the maize of Mexico; the origin of denting in maize; and the genetics of multiple factor characters in North American maize.

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Explanation of Plates 2 to 9

Most of the photographs in these plates are due to the energy and foresight of Prof. Carl Sauer, of the Department of Geography of the University of California, who not only assembled a significant collection of Mexican maize but saw to it that it was expertly photographed. The negatives are now the property of the Museum of Anthropology of that institution, and I am indebted to Mr. E. W. Gifford for permission to use them here. The ears illustrated in pl. 5 and the lowermost ear in pl. 4 are from my own collections; the remainder were collected by Dr. Isabel Kelly. All are reproduced at a little less than natural size.

Plate 2. Three ears of Mexican Narrow Ear varieties. Left to right: from Ameca, Tuxpan, Tuxpan.

Plate 3. Four ears of Intermediate or *maíz chino* varieties. From top to bottom: from Sayula, Ameca, Sayula, Ameca.

Plate 4. Four ears in which the Mexican Pyramidal influence is predominant. The top three ears are from Nochistlán, Zacatecas. The bottom ear is from Tlaltizapán, Morelos. It is an extreme example of the variety known as *pipitillo* which is favored by corn merchants because it shells readily and produces a maximum volume for sale by the litre.

Plate 5. Five ears from high altitudes, showing Mexican Pyramidal influence. The three to the left are from the village of Tlacotepec near Toluca. The two smaller ones show strong evidence of mixture with Mountain Yellow. Right above, with black background, the common popcorn of Toluca (see Appendix, fig. 55, for further data). Right below, ear of an early-maturing purple variety from Acupula near Tepotzotlán, a few miles north of Mexico City. It is Mexican Pyramidal with a strong indication of Mexican Narrow Ear in the compressed butt, husk striations, lower row number, and plant type (See Appendix No. 64).

Plate 6. Four examples of Mountain Yellow from Tapalpa, Jalisco, on the northern flank of the Volcán de Colima.

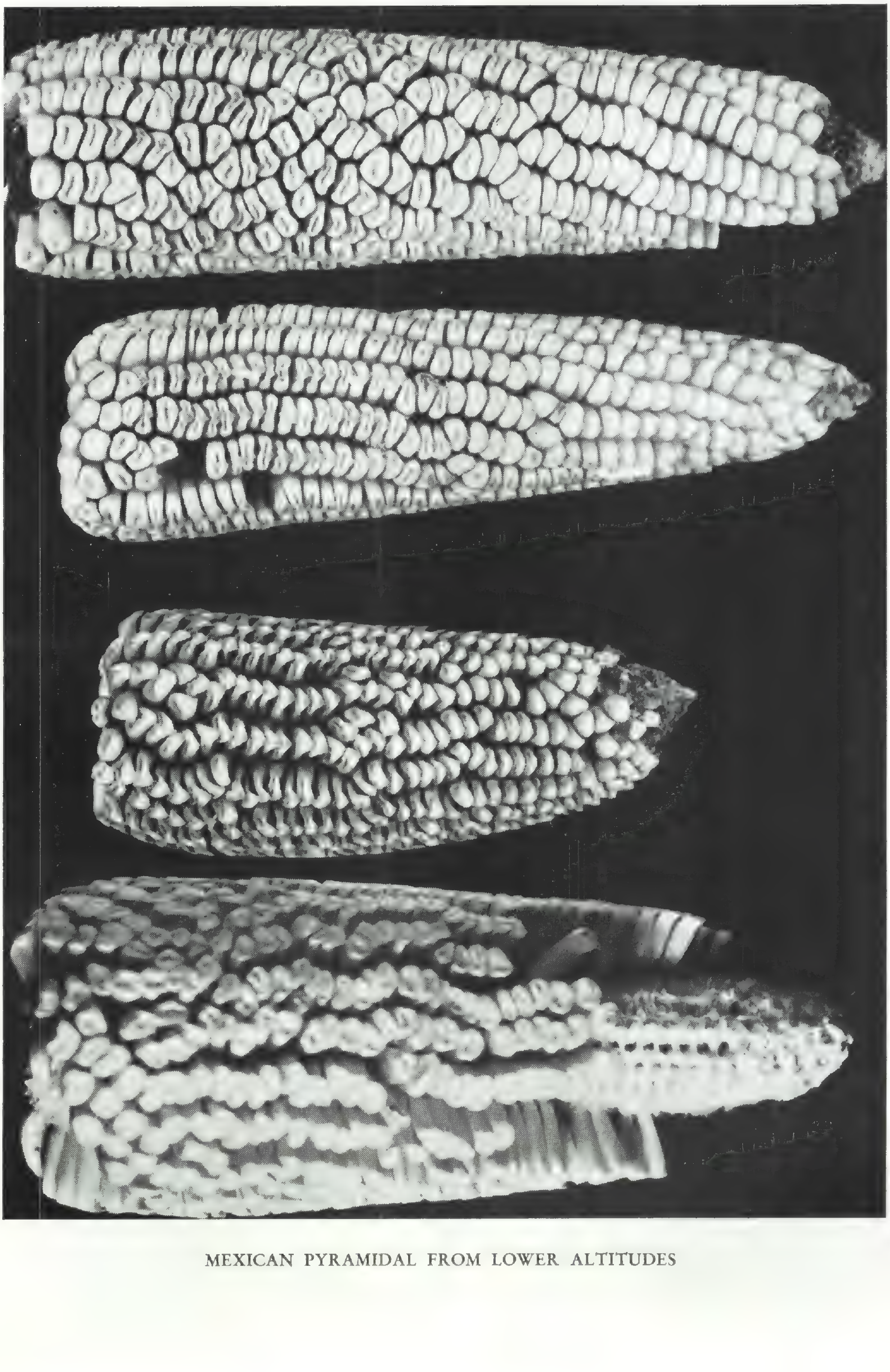
Plate 7. Three examples of "elote" varieties with colored aleurone. The two to the left are from Unión de Tula, Jalisco; the one to the right is from Ameca. Note the single white seed, which probably indicates pollination with dominant white (C^i).

Plate 8. Two ears of *maíz dulce*, a primitive source of sugar, from Unión de Tula, Jalisco.

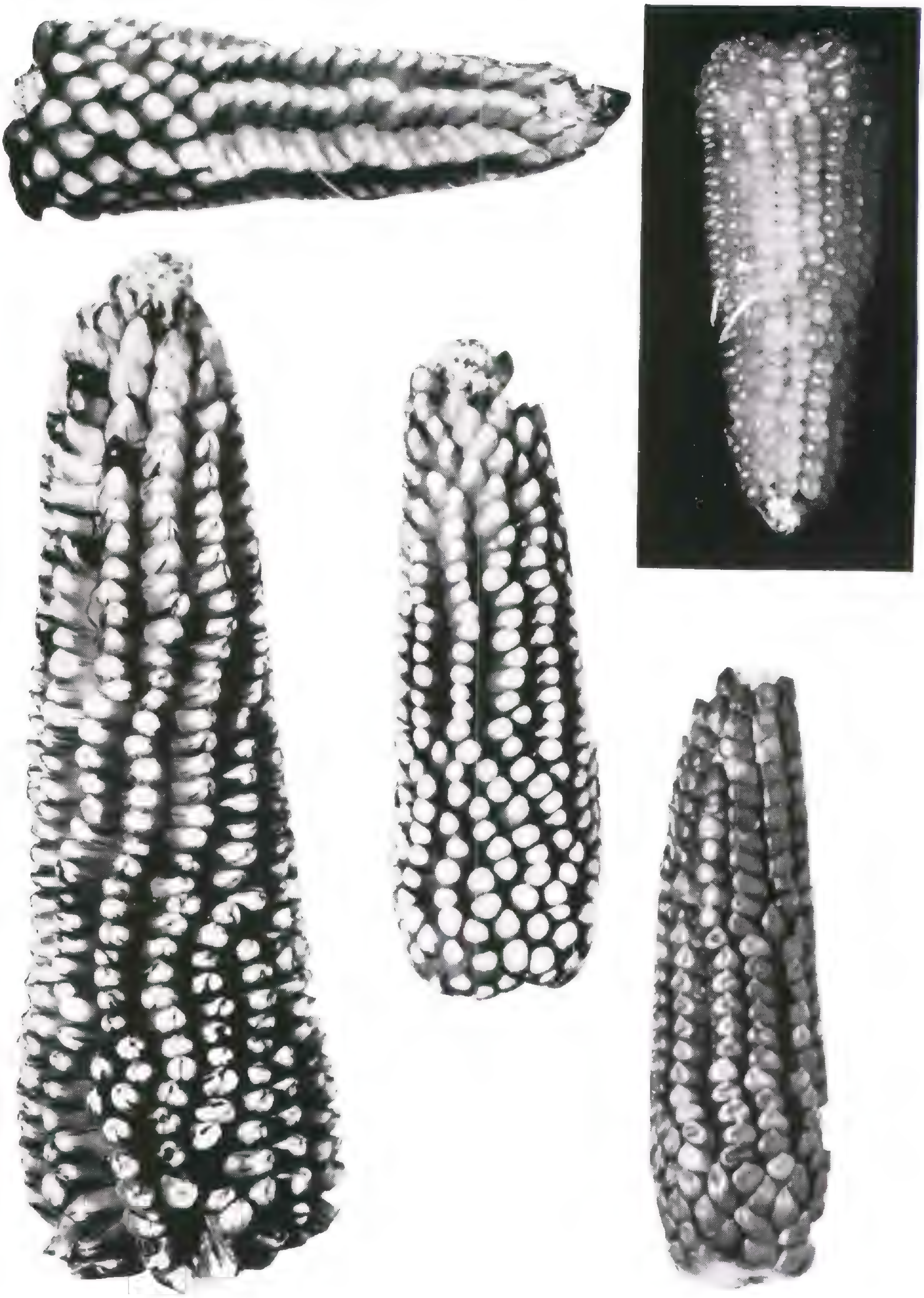
Plate 9. Two ears of *maíz reventador* from Tuxcacuesco, Jalisco (badly damaged by insects) and one from Sayula, Jalisco. Lower right, two ears of *maíz chapolote* from an *ejido* near Culiacam, Sinaloa, Mexico.

MEXICAN NARROW EAR

INTERMEDIATES



MEXICAN PYRAMIDAL FROM LOWER ALTITUDES

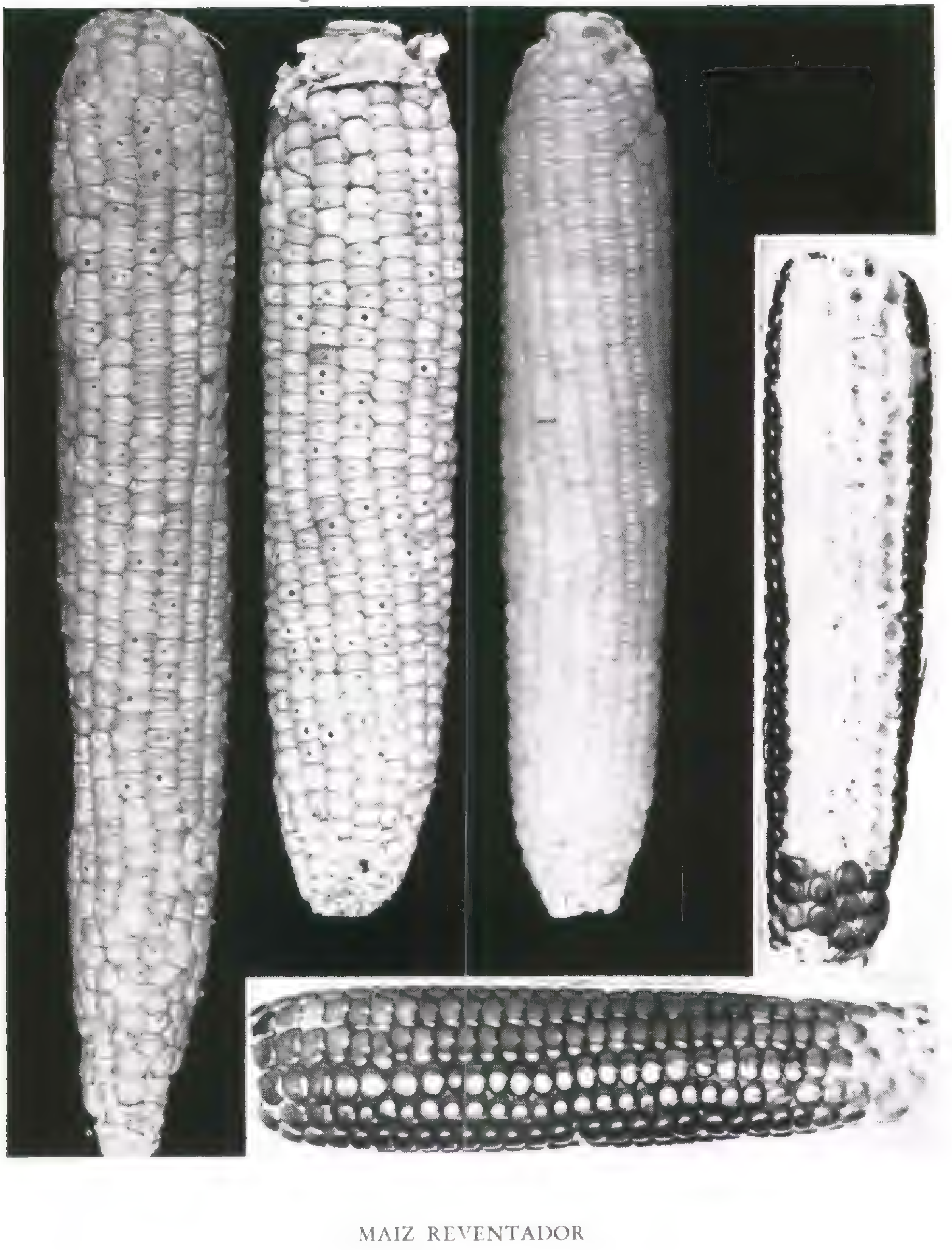


MEXICAN PYRAMIDAL FROM HIGHER ALTITUDES

MOUNTAIN YELLOW

ELOTE VARIETIES

MAIZ DULCE



MAIZ REVENTADOR

Maize Collections from Mexico

FOREWORD

The following records and photographs are an attempt to sample and record the common, every-day corn of Mexico. Much of it is from villages off the highway and the railroad; of the 72 samples only two represent the finest corn which could be raised in that particular vicinity. Varieties of spectacular productivity can be, and are, grown in Mexico; in this survey they were rather deliberately avoided. The old-fashioned varieties of the small growers give a clearer picture of what indigenous Mexican maize was like before its variation pattern had been blurred by modern commerce.

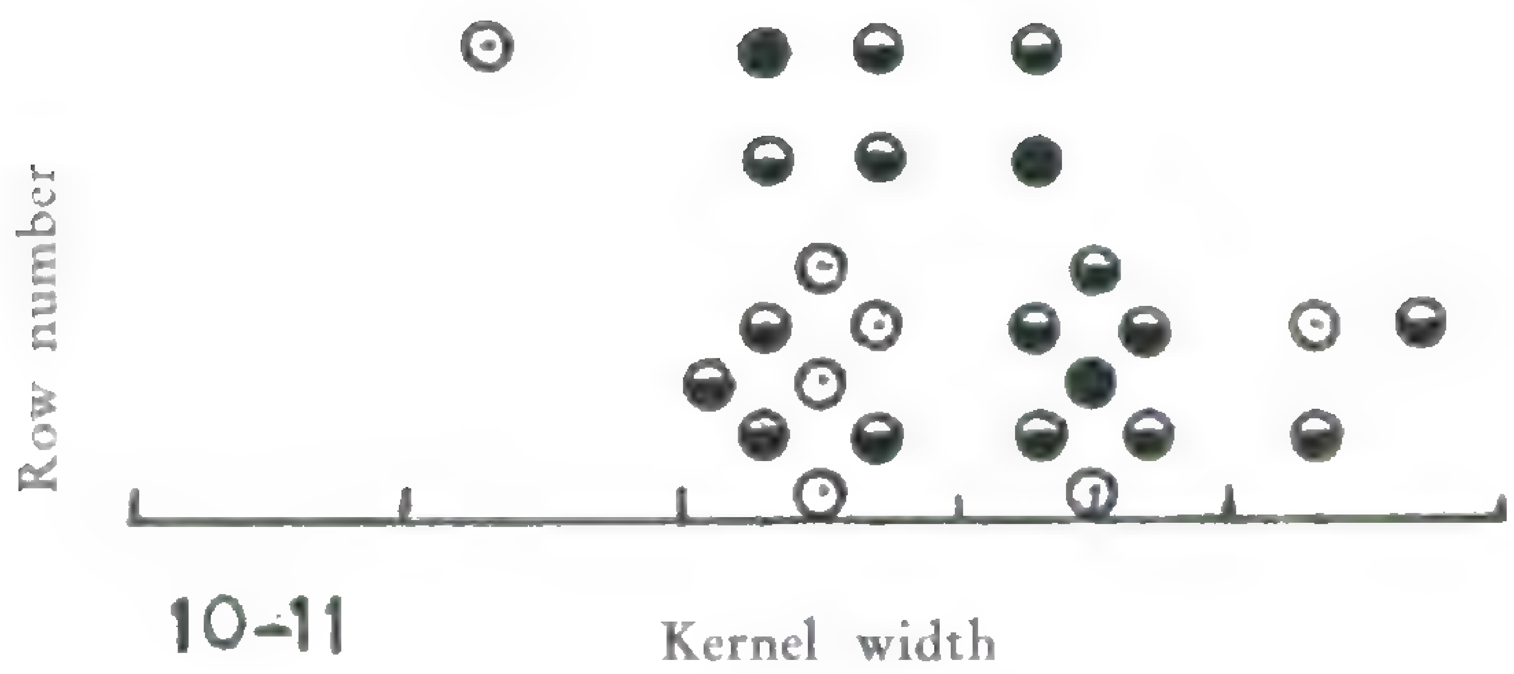
The grid used in each diagram has been explained in fig. 2 of the paper to which this is an appendix. Row numbers from 8 to 22 are diagrammed on the vertical axis at the left; kernel widths in mm. are diagrammed on the horizontal axis across the base of the diagram. The first division of the scale represents 4–5 mm., the second 6–7, and so on up to 16–17 at the right. The same grid to the same scale has been used throughout. For a few of the collections with very wide kernels only the right-hand end of the scale is represented. The vertical scale (though not drawn) is the same as in all the other diagrams and can be obtained by measurement. The horizontal scale begins at 10–11 mm. instead of at 4–5 mm. and is so indicated in each diagram.

It might be well to point out that although these grids resemble the scatter diagrams made in preparing a correlation table, they are a cruder device. They are nothing but a set of pigeon-holes classifying all the ears of maize simultaneously according to row number and kernel width, and diagramming their denting and kernel pointing in a graphic manner. The ears that fall in each square (each separate pigeon-hole, that is) are diagrammed as close to the center as is practicable; the arrangement within the square has no significance.

The photographs are all snap-shots made with a Leica camera. All but one have been printed to the same scale. Most of the pictures include the calipers used in making the measurements, and in each case the calipers were set to exactly 5 cm. In so far as possible the ears which are photographed represent a random selection from the field or crib. Where local pride prevented the illustration of a typical sample, this has been indicated in the notes.

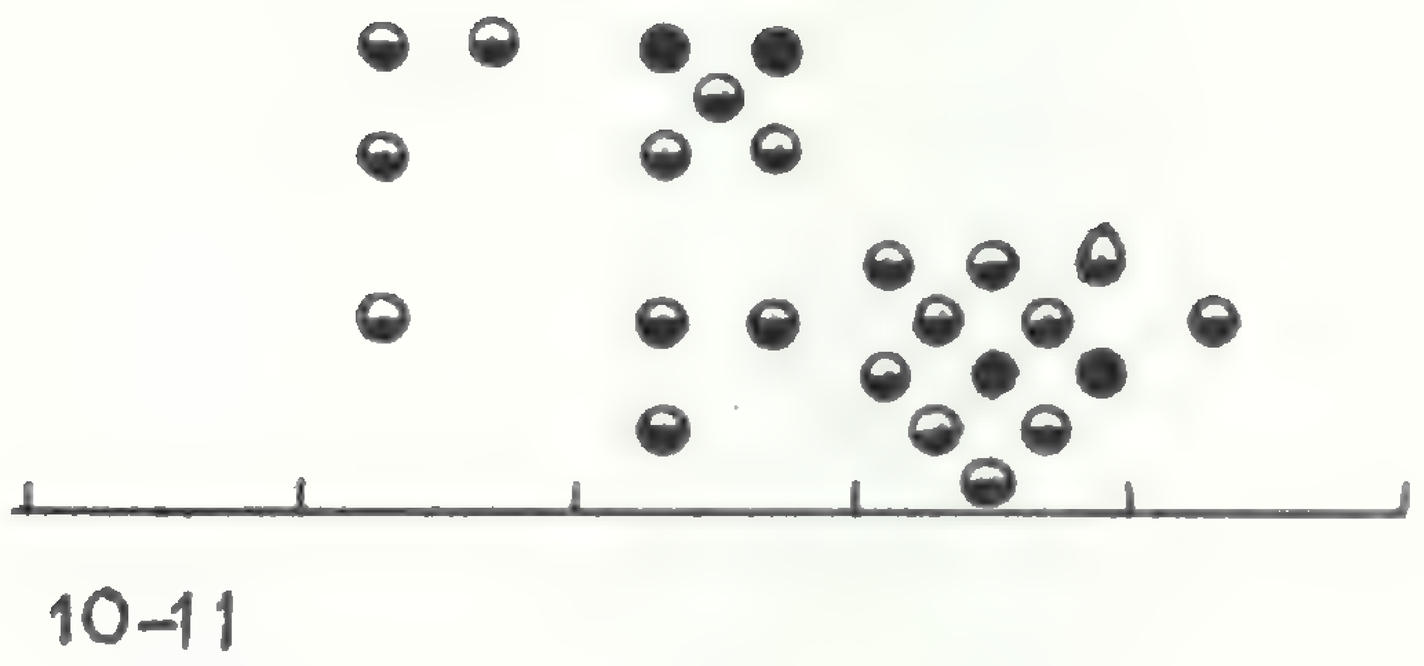
Kernel color was scored separately for each ear that was measured, and the summaries below each picture are an exact digest of accurate notes. Cob color was not recorded in so systematic a fashion, and the lack of any mention of red or purple cobs is no indication that they were not present in the sample.

For a variety of reasons the Appendix does not exactly coincide with the collections reported in Table I but in general the collections are represented in both places. In the Appendix, as in the table, the collections are arranged according to Mexican states and roughly from west to east within each state. They were mostly made on the plateaus of central Mexico and the lower flanks of the mountains which rise above these plateaus. Aside from a few scattering collections from other parts of Mexico they are from a region about 300 miles in extent, from a little west of Guadalajara to the vicinity of Mexico City.



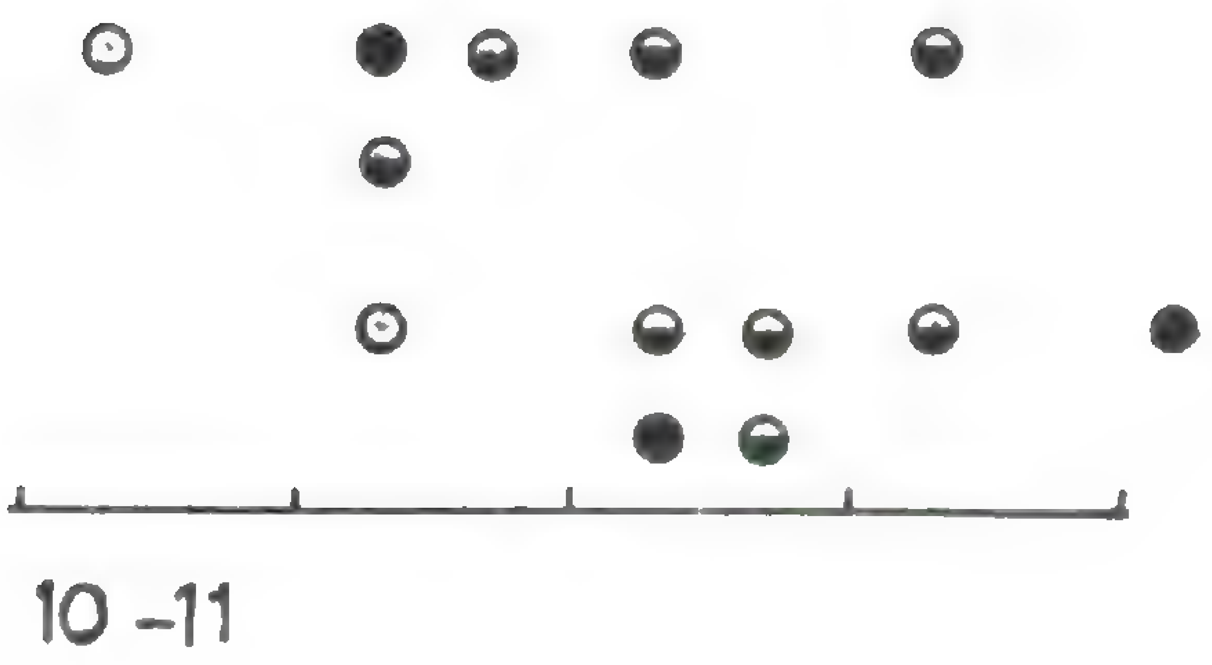
1. Autlán, Jalisco. *Maíz criollo*

From a small grower at the edge of town. Prevailingly white though a majority of the ears had a few yellow kernels and a few ears had many. One ear had a tan pericarp and one had four kernels with colored aleurone, three of which were *pr*, and one *Pr*. Horizontal scale shifted to the left (as indicated) to accommodate wide kernels. Vertical scale as in No. 4.



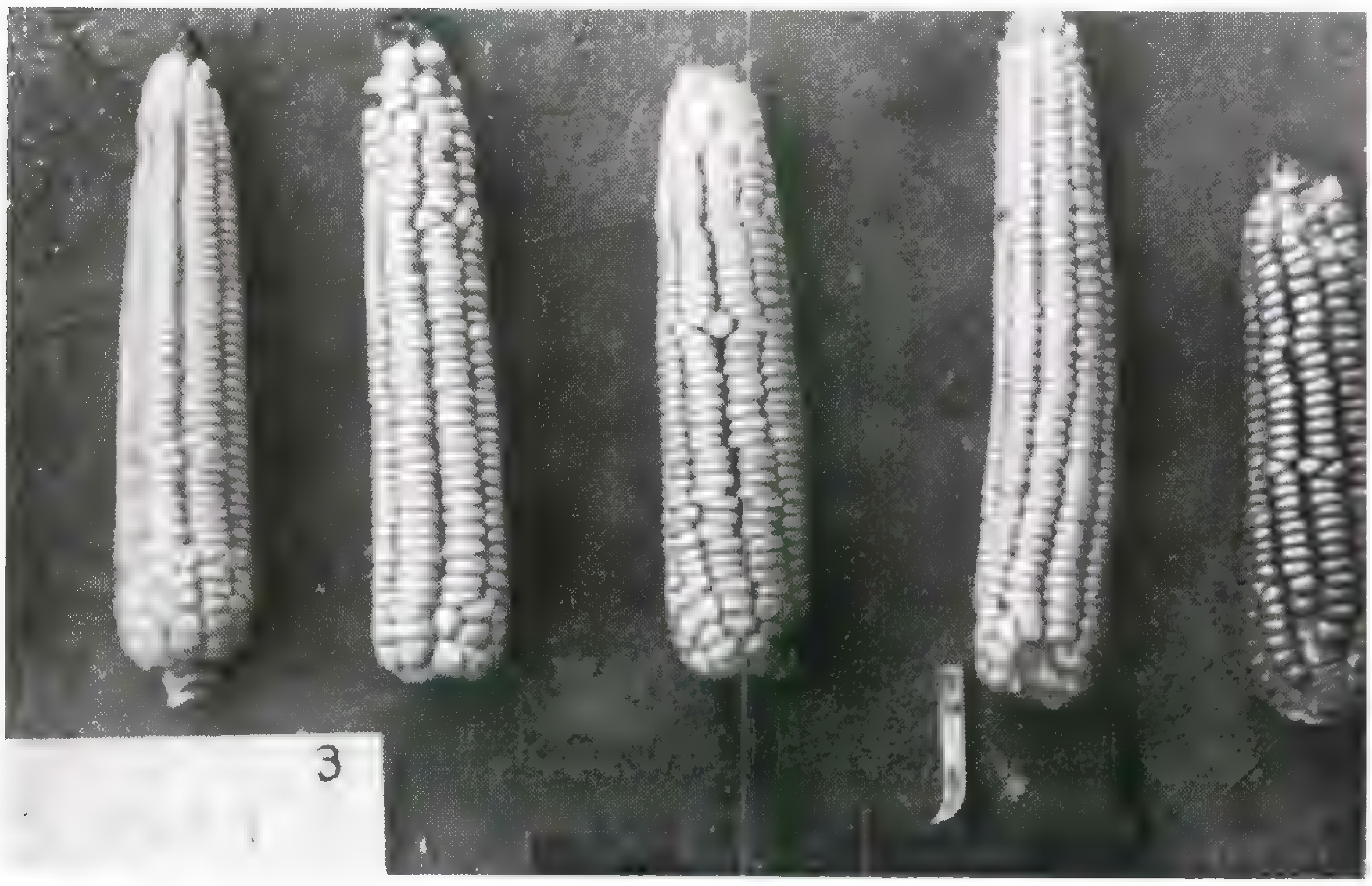
2. El Grullo. *Maíz humiado*

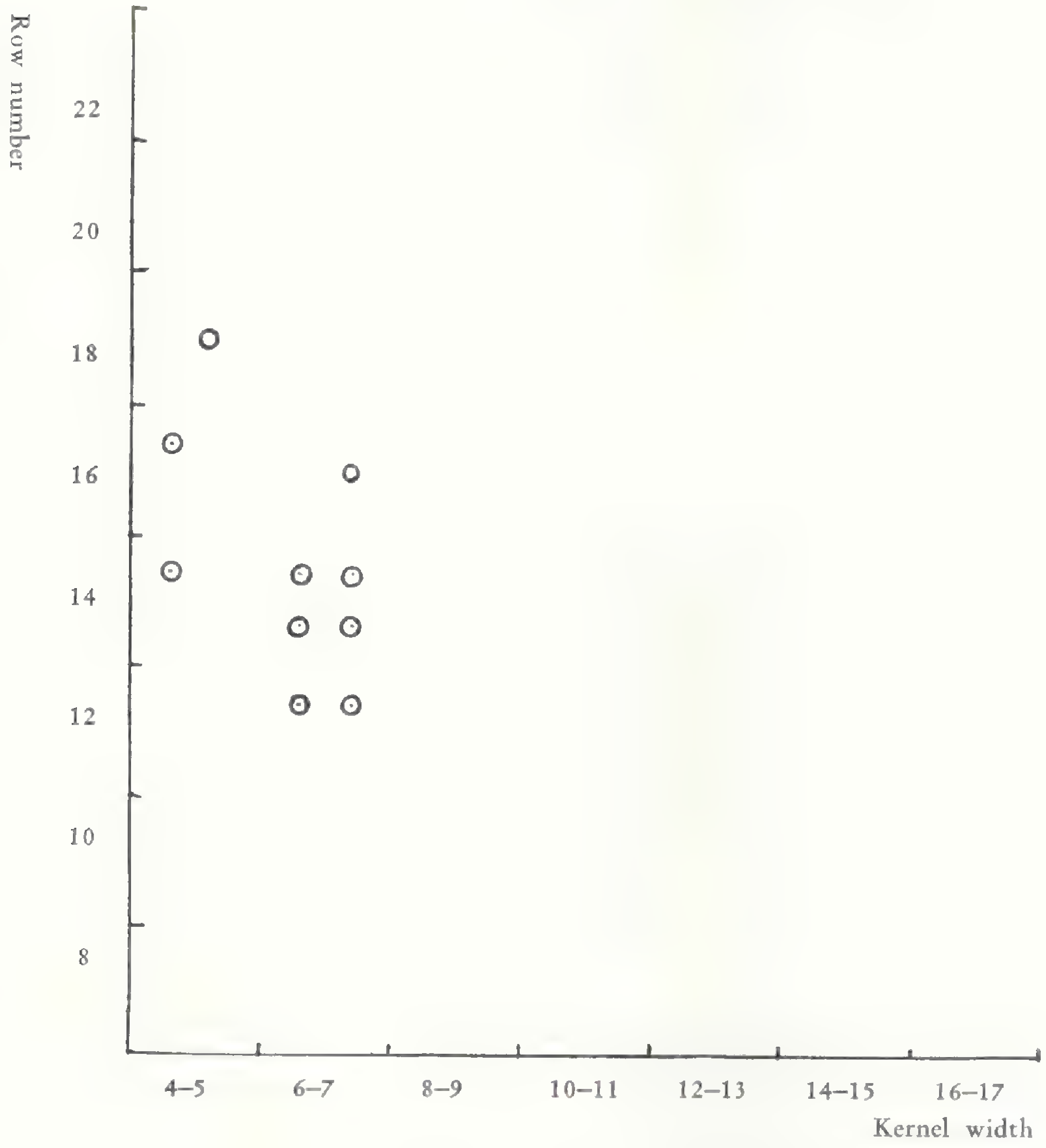
The name (literally "smoked") refers to the tan pericarp which characterized all but eight of the ears. Probably most of these also exhibited this character but in too dilute a state for recognition without dissection of the pericarp. Over half the ears had at least a few kernels with yellow endosperm. One ear bore a single kernel with colored aleurone *(Pr.)*. Horizontal scale as in No. 1; the vertical scale, though not shown, is the same in the first three collections as in those that follow.



3. El Chante, near Autlán, Jalisco. *Maíz humiado*

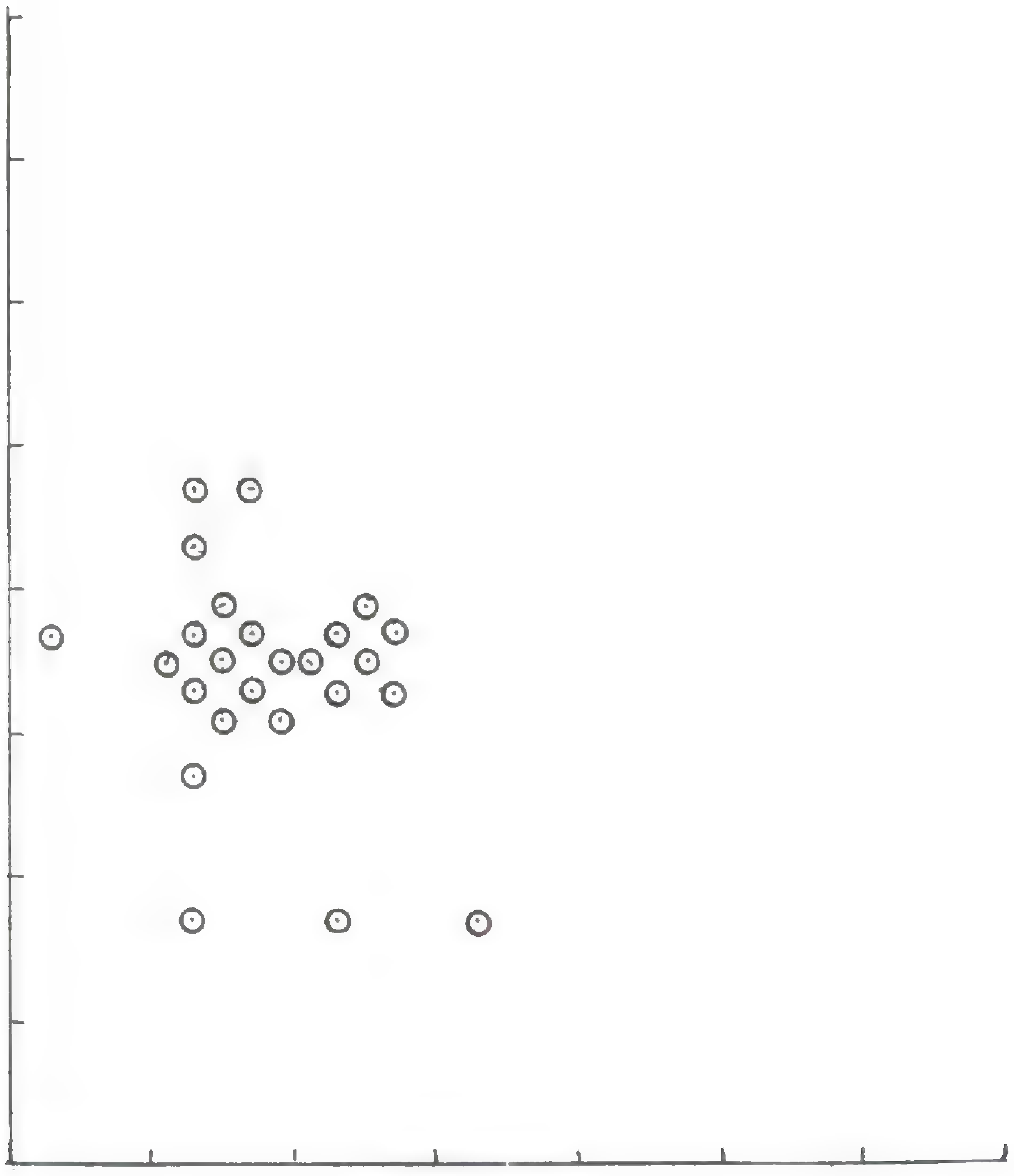
A sample of thirteen ears obtained for me by Don José Maria Corona. Very similar to No. 2.





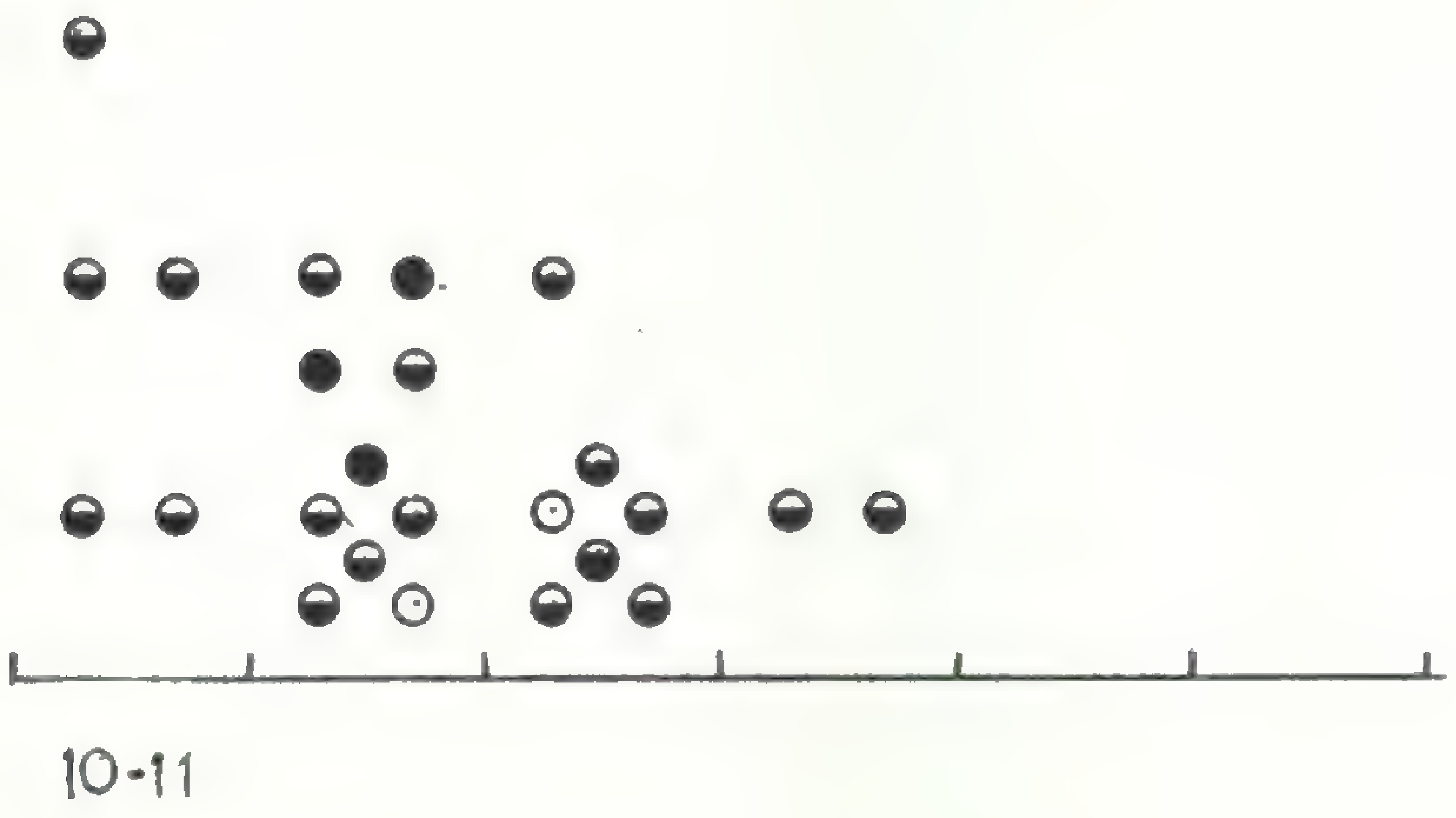
4. El Limón, Jalisco. *Maíz reventador*

A sample of ten ears abtained by Don José Maria Corona. Prevailingly white. The few colored kernels were all *pr.* Ears similar to those shown in pl. 9 and in the following collection. Scale as in fig. 2. Vertical scale: row numbers from 8 to 22; horizontal scale: kernel width from 4–5 to 16–17 mm.



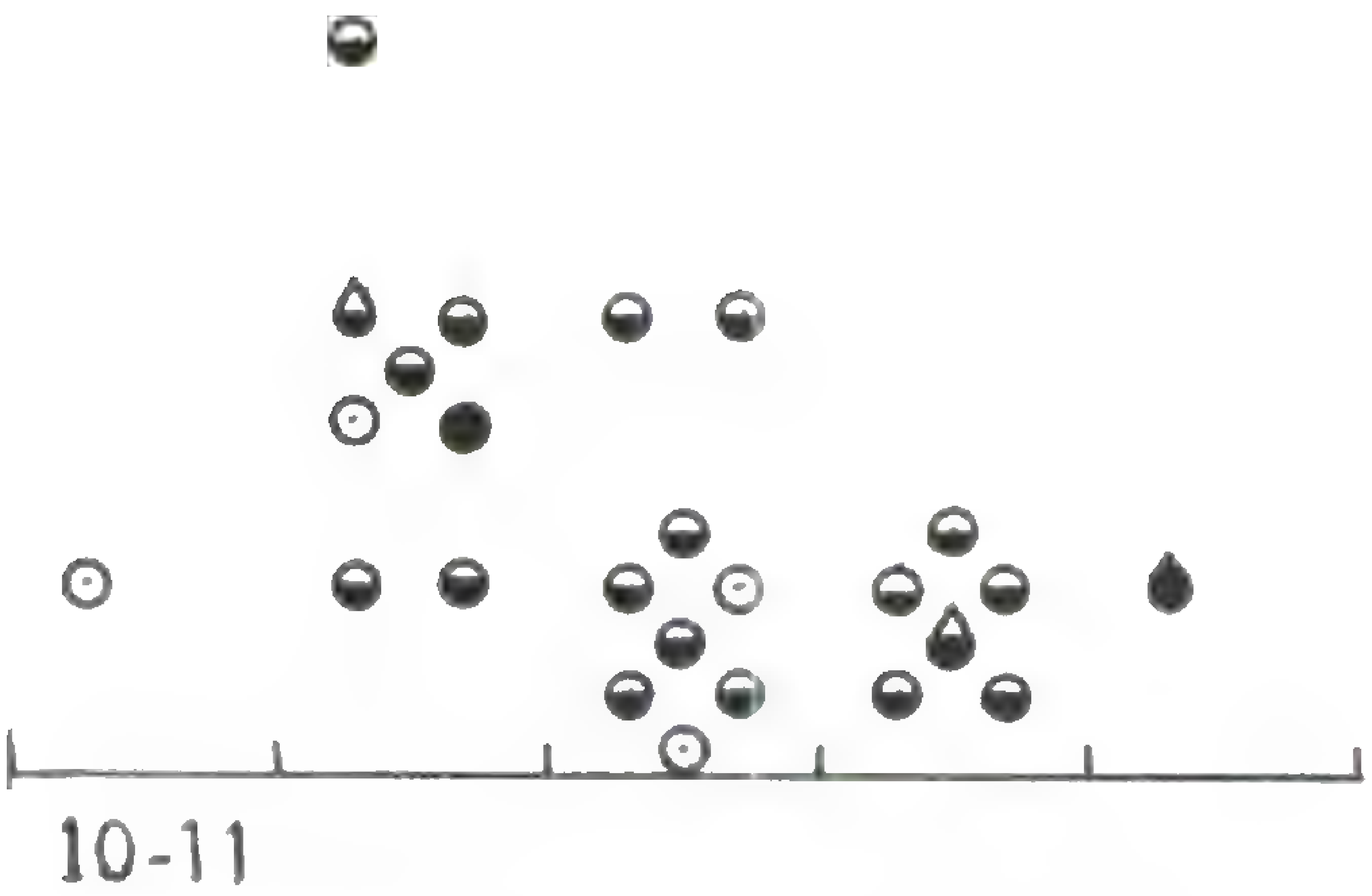
5. Chachahuatlán, Jalisco. *Maíz reventador*

Maíz reventador, the ancient popcorn of western Mexico, has been the subject of a special monograph (see Bibliography, Anderson, '44).



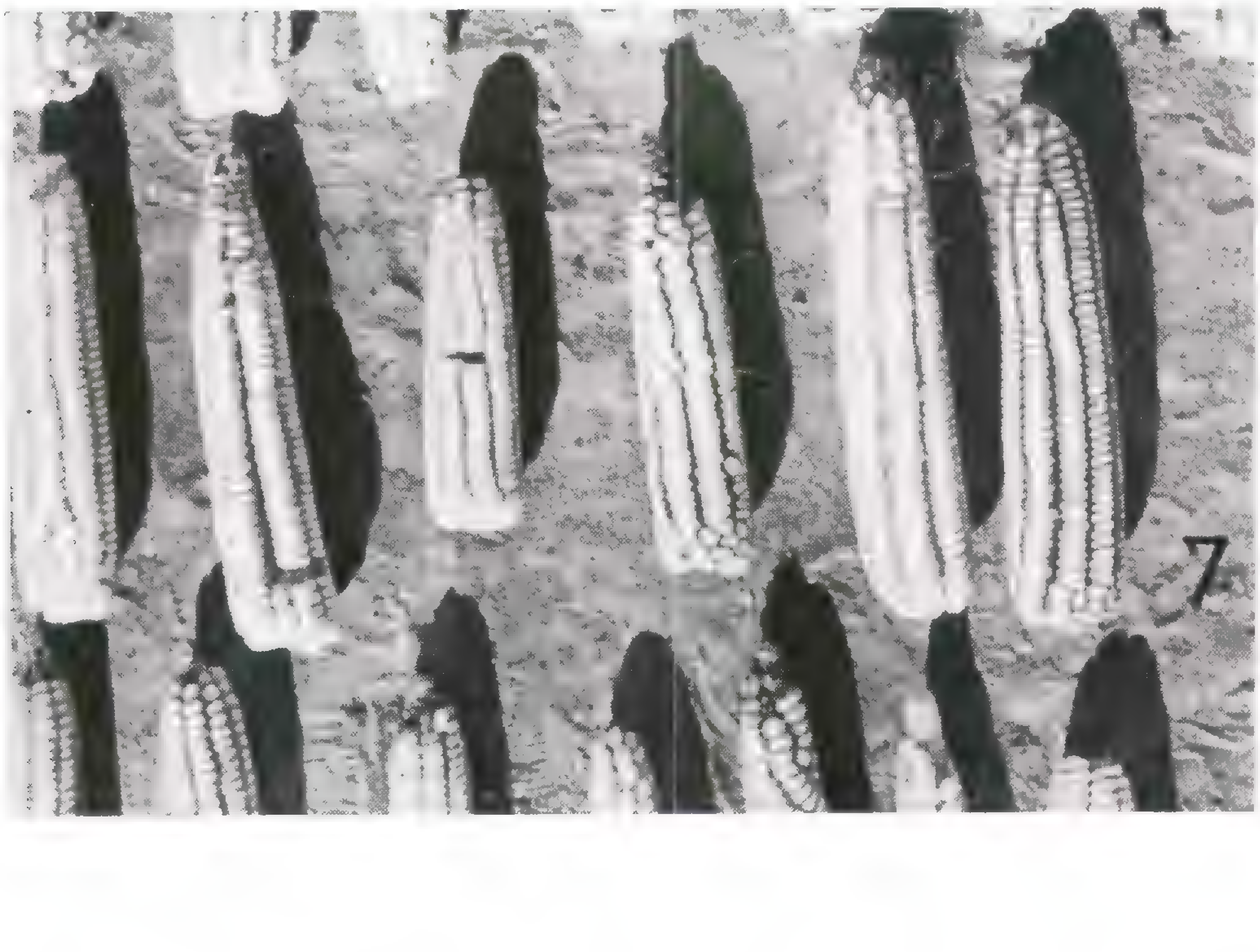
6. Chachahuatlán, Jalisco. *Maíz colimote*

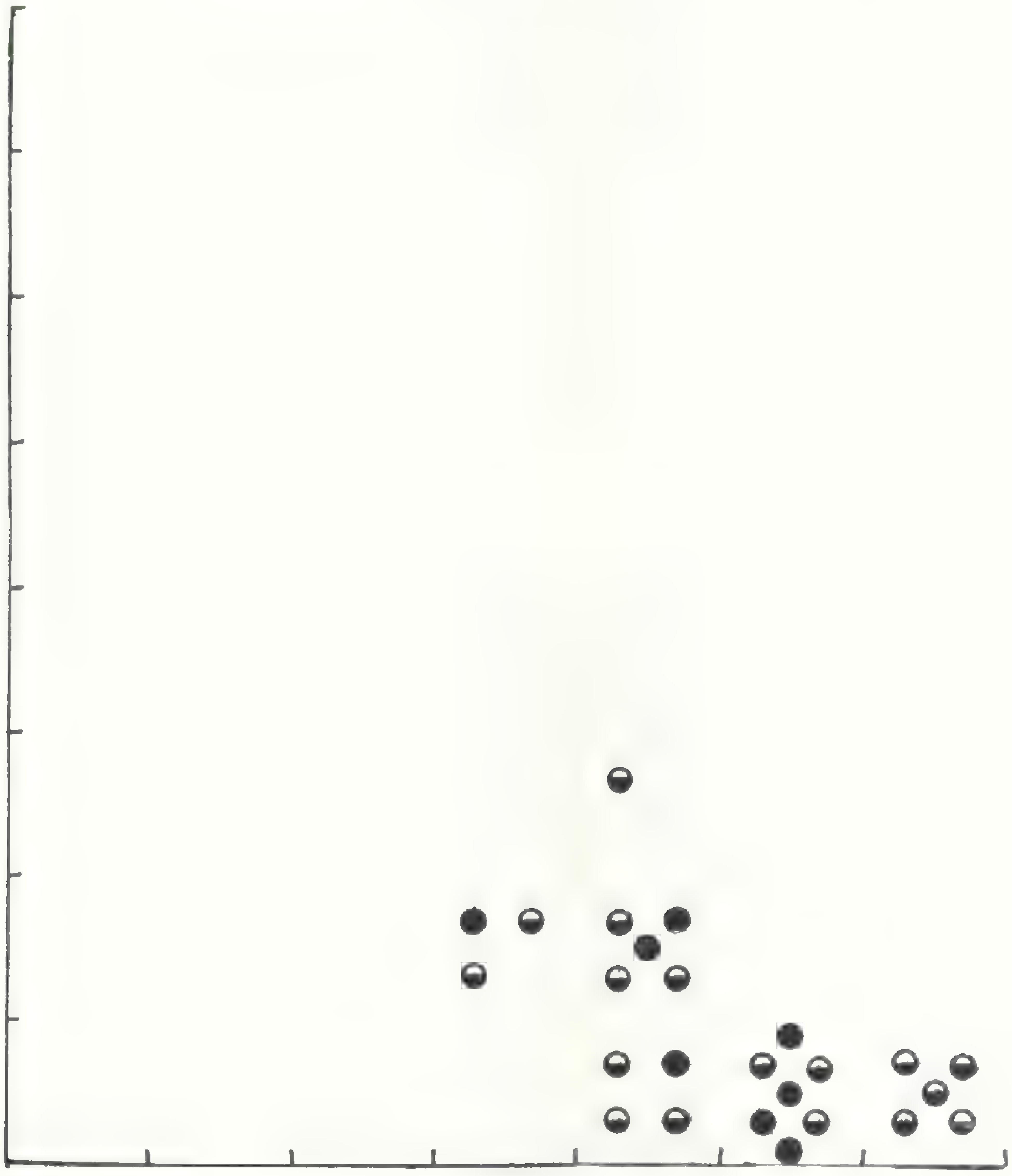
From an old *hacienda* a few miles down the river from Tuxcacuesco. The corn was prevailingly white though most of the ears had at least a few yellow kernels. Four of the ears had kernels with colored aleurone (mostly *Pr*, one *pr*). Four of the ears had faint pericarp color (P^{cr}). The name means "from Colima," which is not far distant. Note change in position of the scale.



7. San Gabriel, Jalisco. *Maíz blanco*

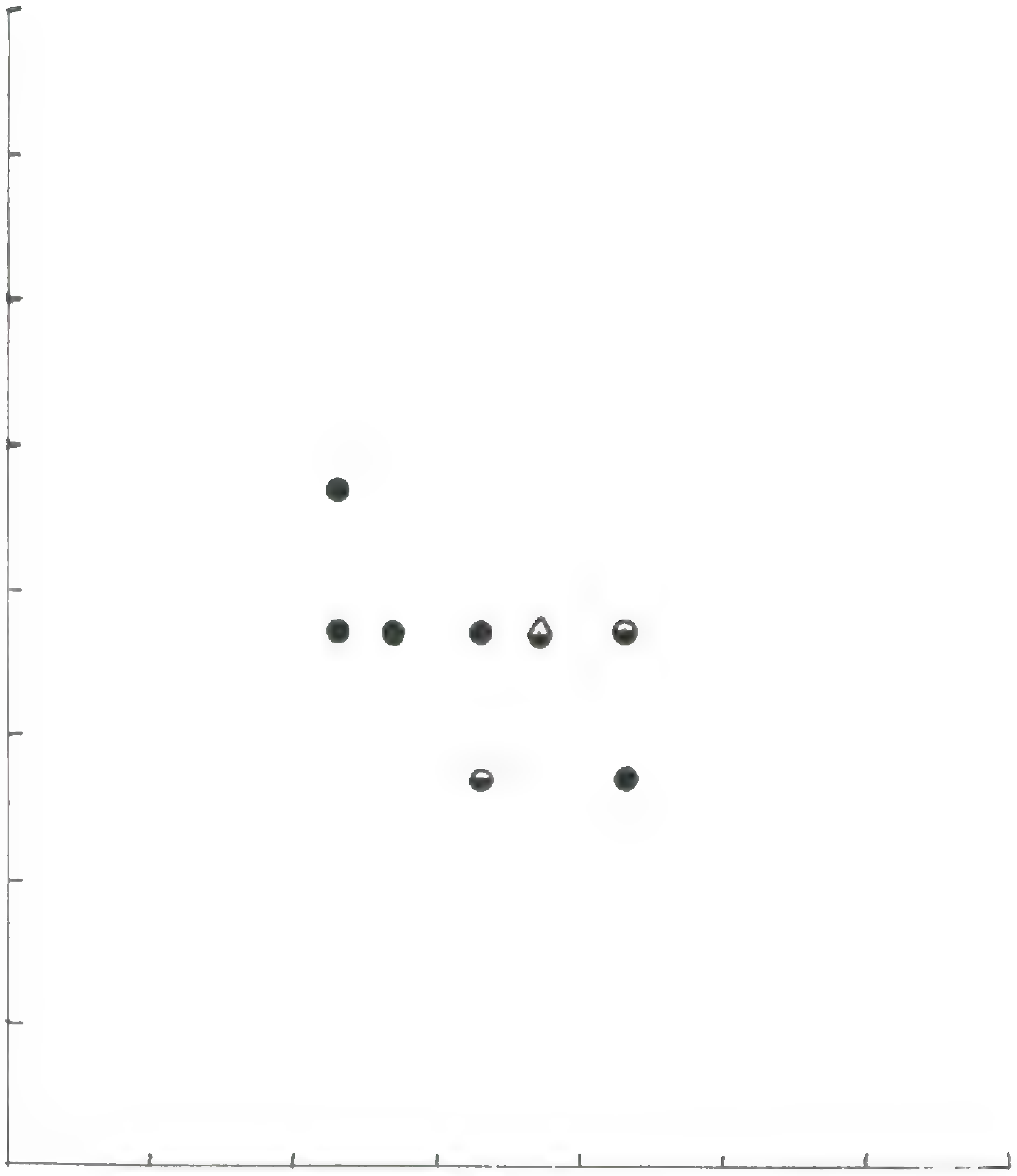
Two of the ears showed a tan pericarp; one had mosaic pericarp (P^{mo}). The corn was prevailingly white, a few ears showed yellow kernels. Scale shifted to left because of very wide kernels.





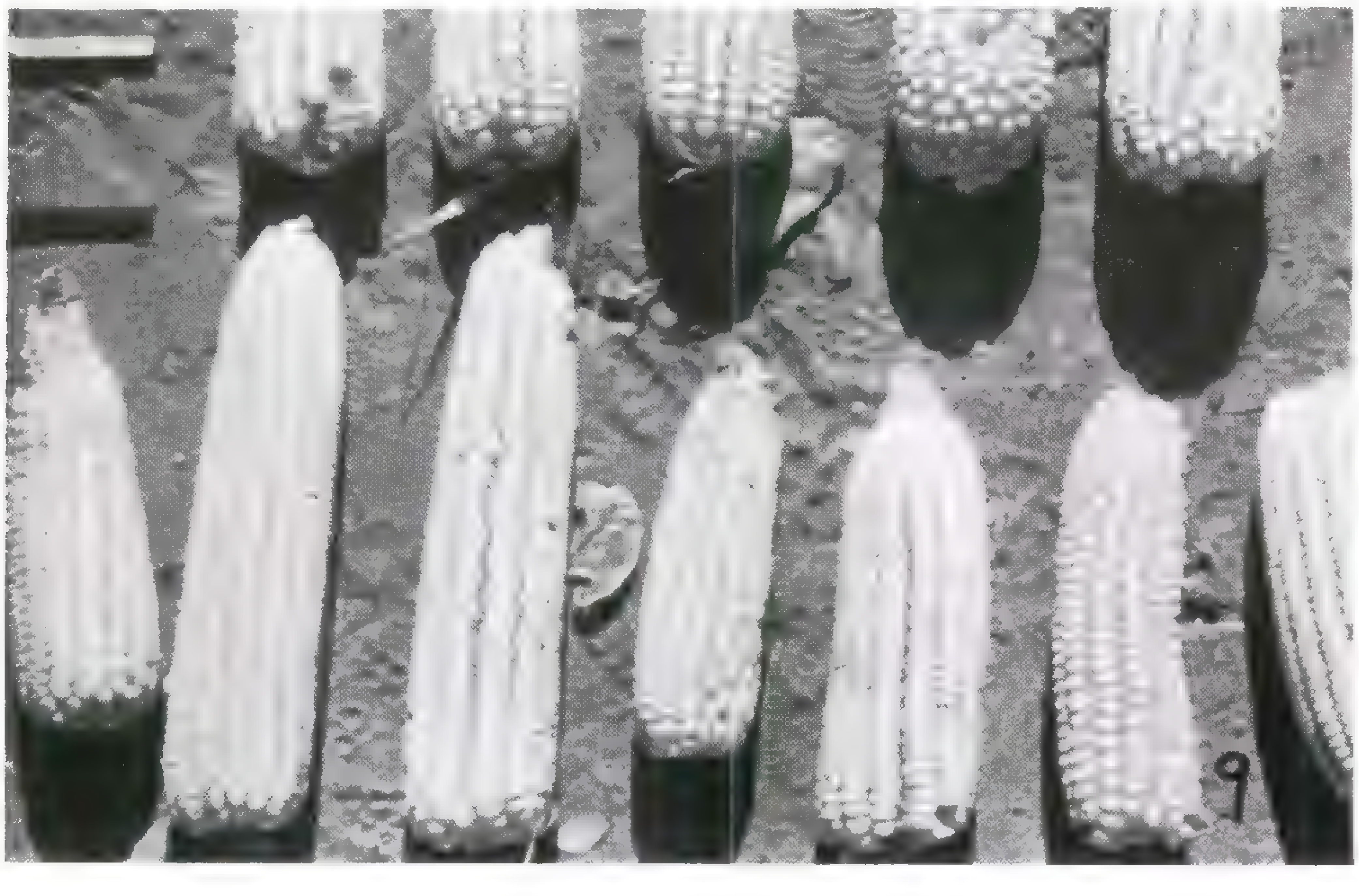
8. Tuxcacuesco, Jalisco. *Maíz blanco*

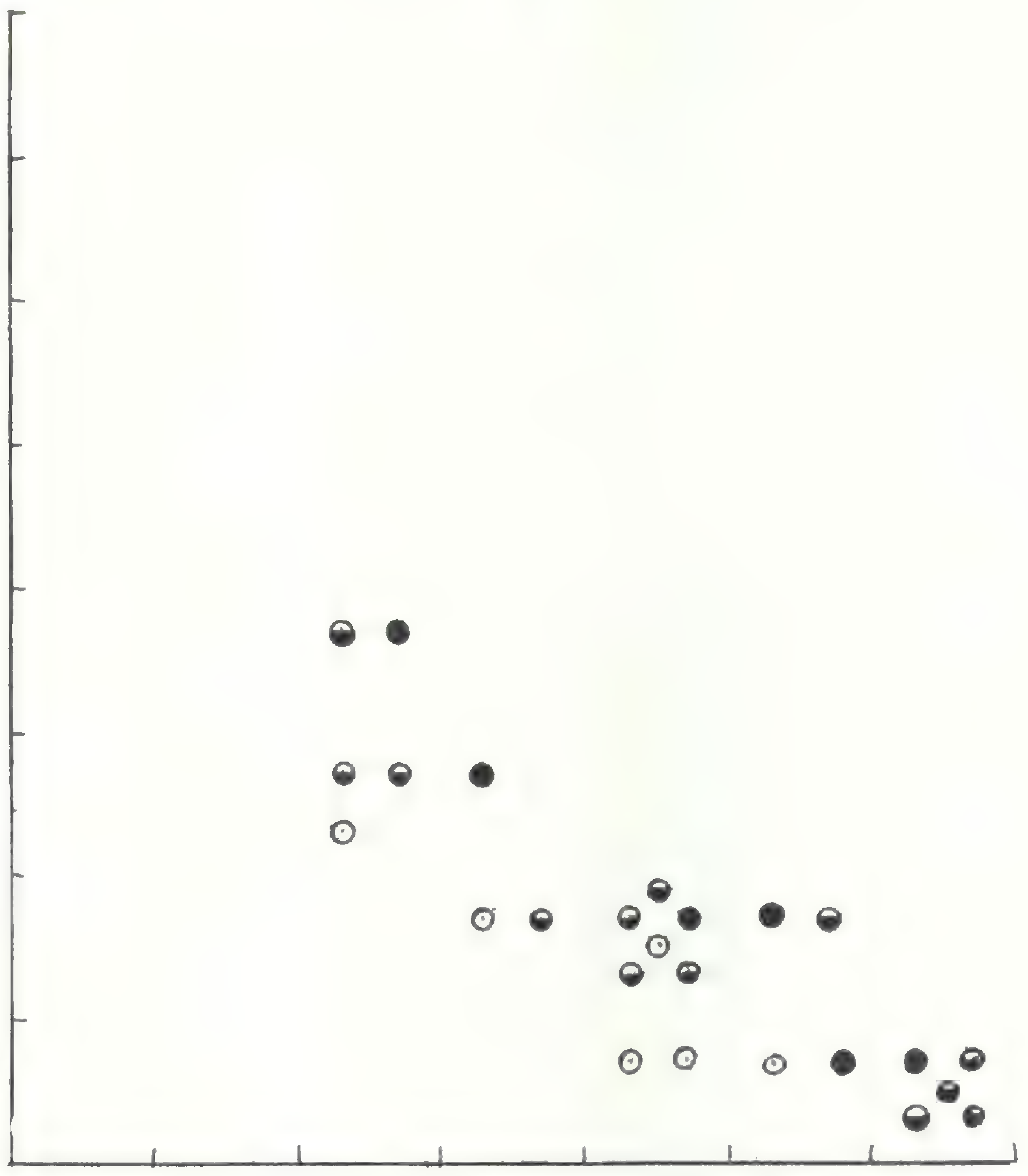
The kernels of this variety were all heavily and conspicuously capped with soft white starch. Prevailingly white, a few ears with occasional yellow kernels and a very few with colored aleurone *(Pr* and *pr).*



9. Palmar, Jalisco

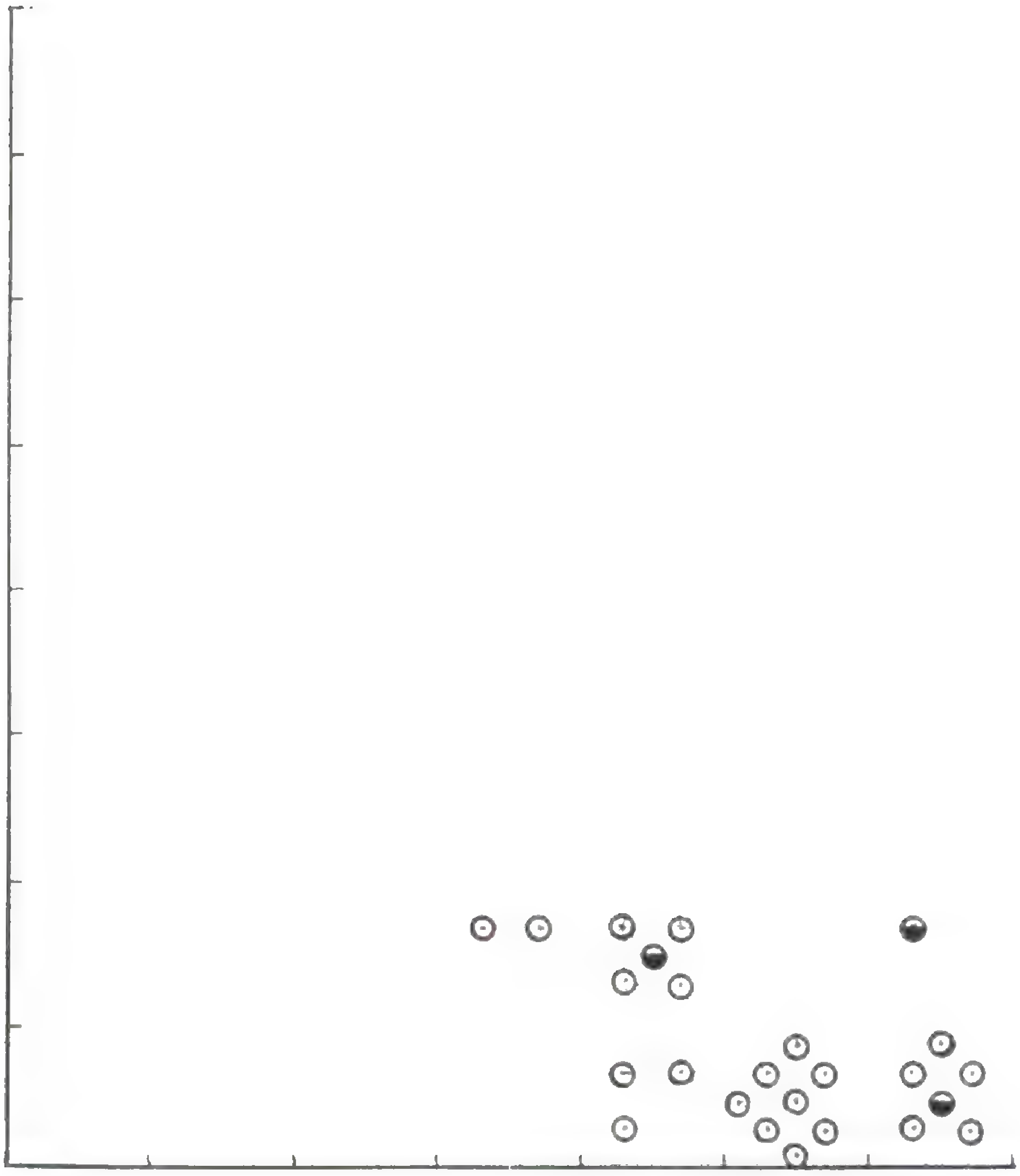
From clearings in the mountains a few miles west of Tuxcacuesco. Prevailingly white with many yellow kernels and some yellow ears.





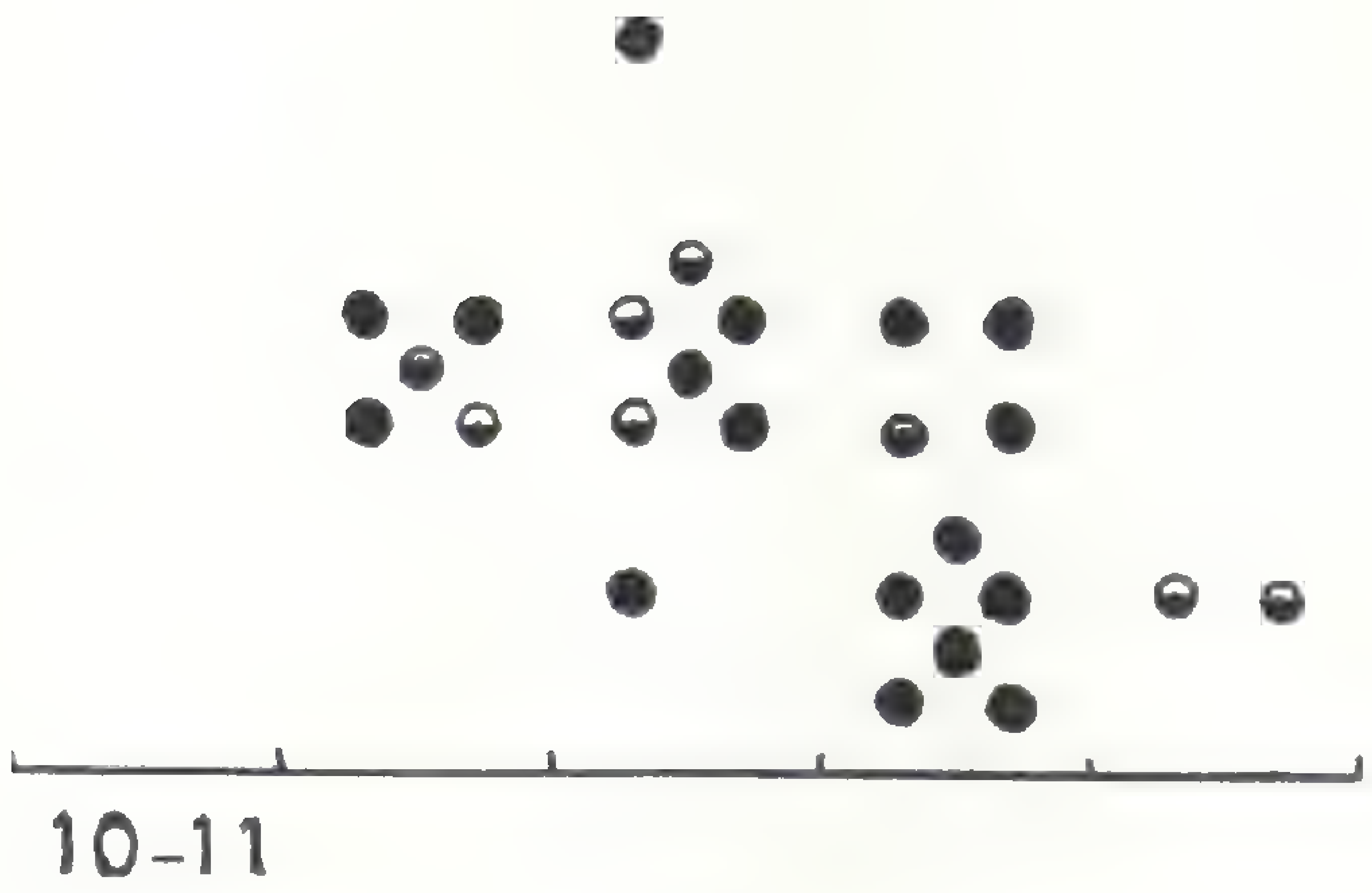
10. Ameca, Jalisco. *Maíz amarillo*

Bought in the sack by the family who let me measure it. Probably came from some of the mountains near by. Shows a strong infusion of Mountain Yellow. Prevailingly yellow. Eight of the ears had tan pericarp, one a pale pink pericarp. Most of the ears were segregating for bright versus pale yellow.



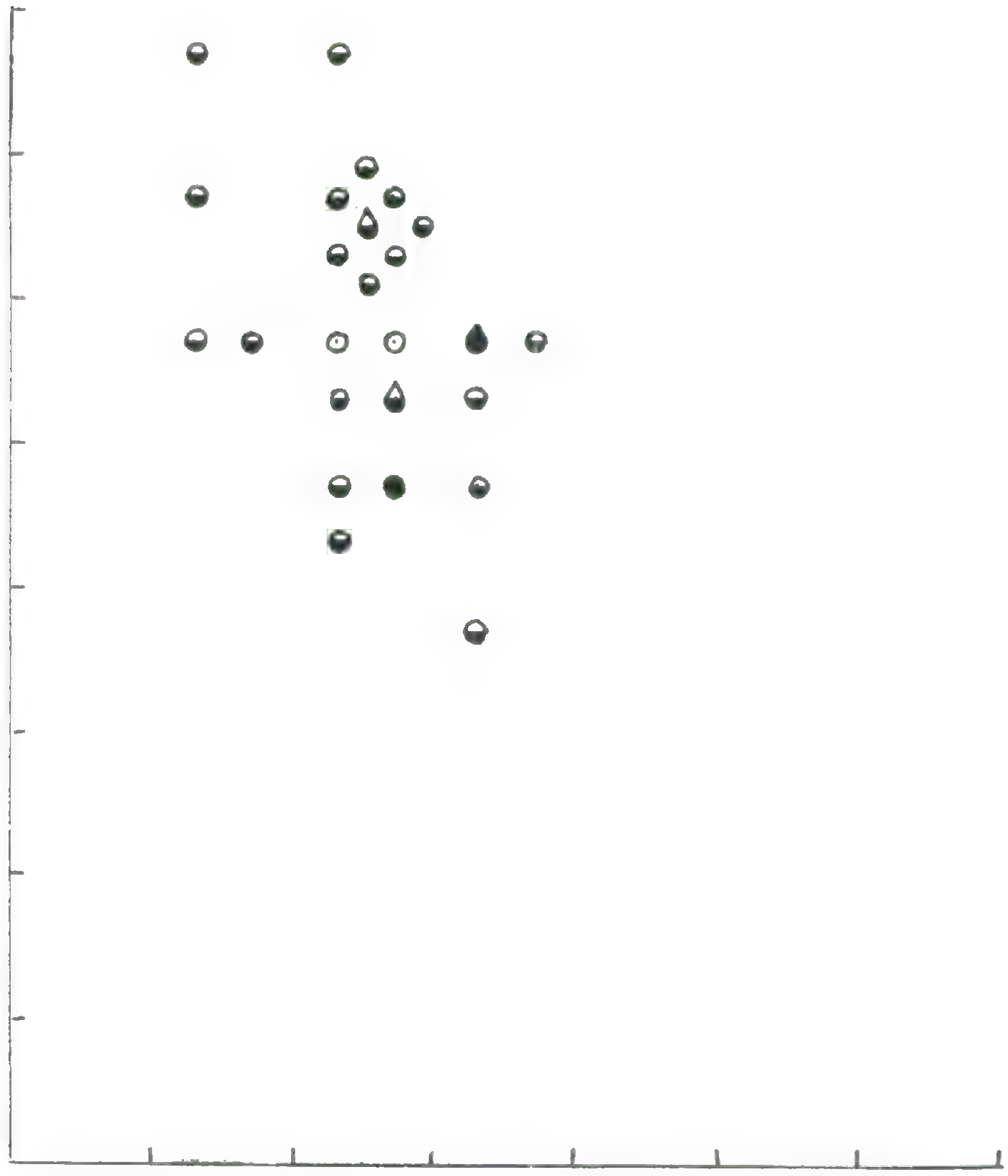
11. Ameca, Jalisco. *Maíz liso*

A smooth, glistening flint, as the name implies. Said to be very common in the region between Ameca and the coast. Two examples were found in a casual survey of corn being stored or sold in the central part of the city. Said to be used sometimes as a popcorn. Prevailingly white with a few yellow kernels on nearly every ear.



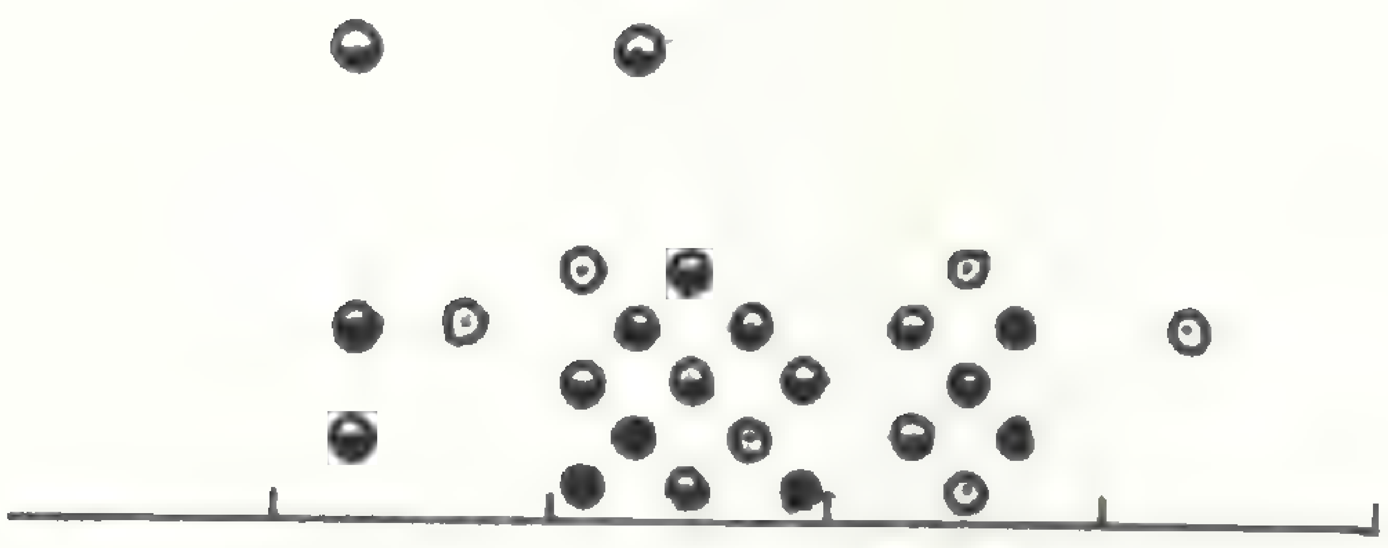
12. Ameca, Jalisco. *Maíz areneño*

This variety is so wide-kernelled that the scale has had to be shifted as noted in the diagram. Yellow and white, heavily capped with soft starch and uniformly dented with a smooth, even dent. A few kernels with colored aleurone *(Pr)*.



13. Tlajomulco, Jalisco. *Maíz dulce* (See plate 8)

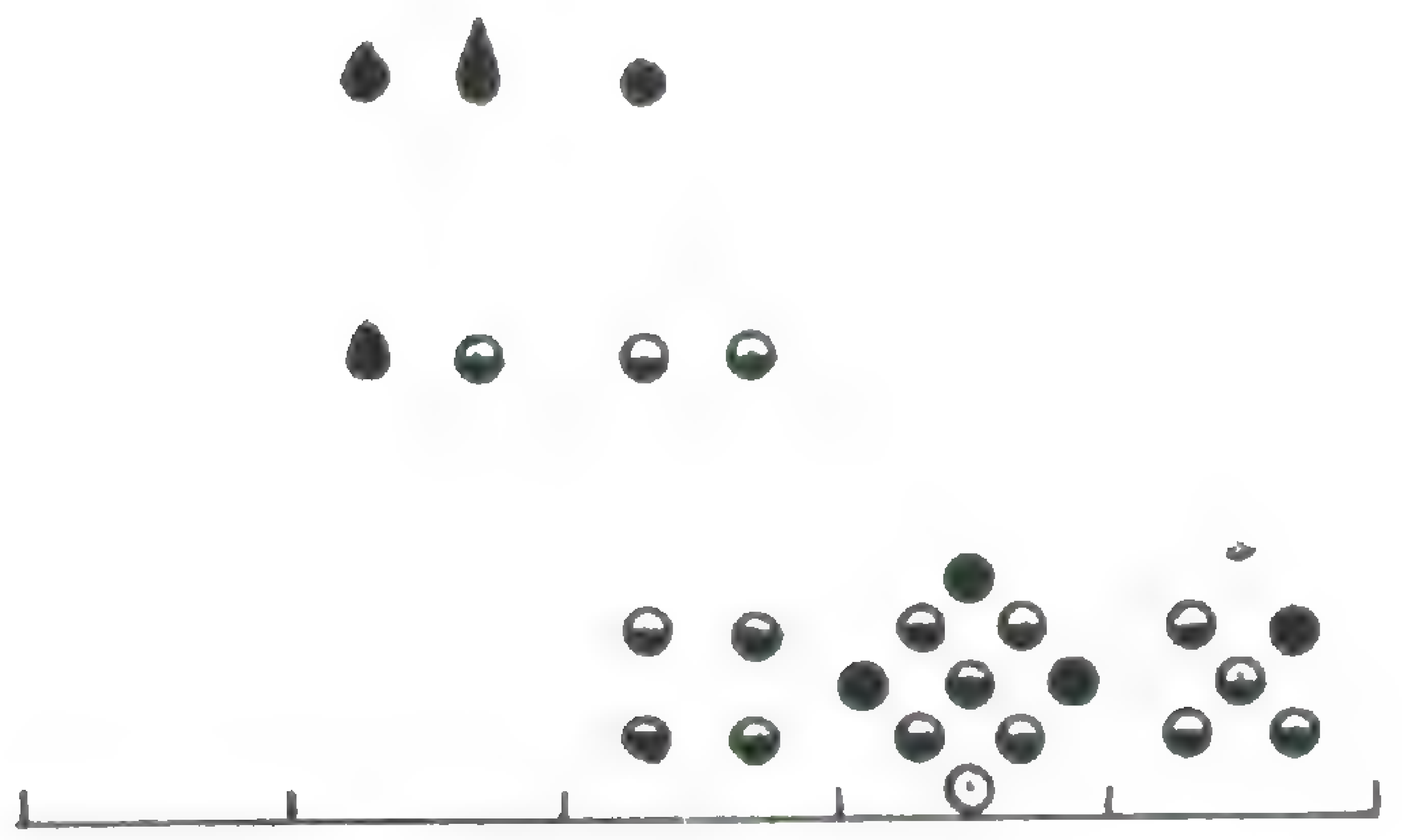
This variety has been the subject of a special monograph by Kelly and Anderson. It had been grown in a garden with a red aleurone "elote" variety, apparently for more than one season since one ear was segregating. All the contaminated kernels were *pr* rather than *Pr*. *Maíz dulce* is homozygous for sweet endosperm, but a few of the ears showed partial suppression of the sweet and these ears all had high row numbers (20 or above) and were evenly tapered like Mexican Pyramidal. The denting was scored on the contaminated kernels. The *pr* kernels were usually spotted rather than evenly flushed with color. All the ears had yellow endosperm with varying amounts of dull red in the pericarp (various alleles of P^{cr}).



10-11

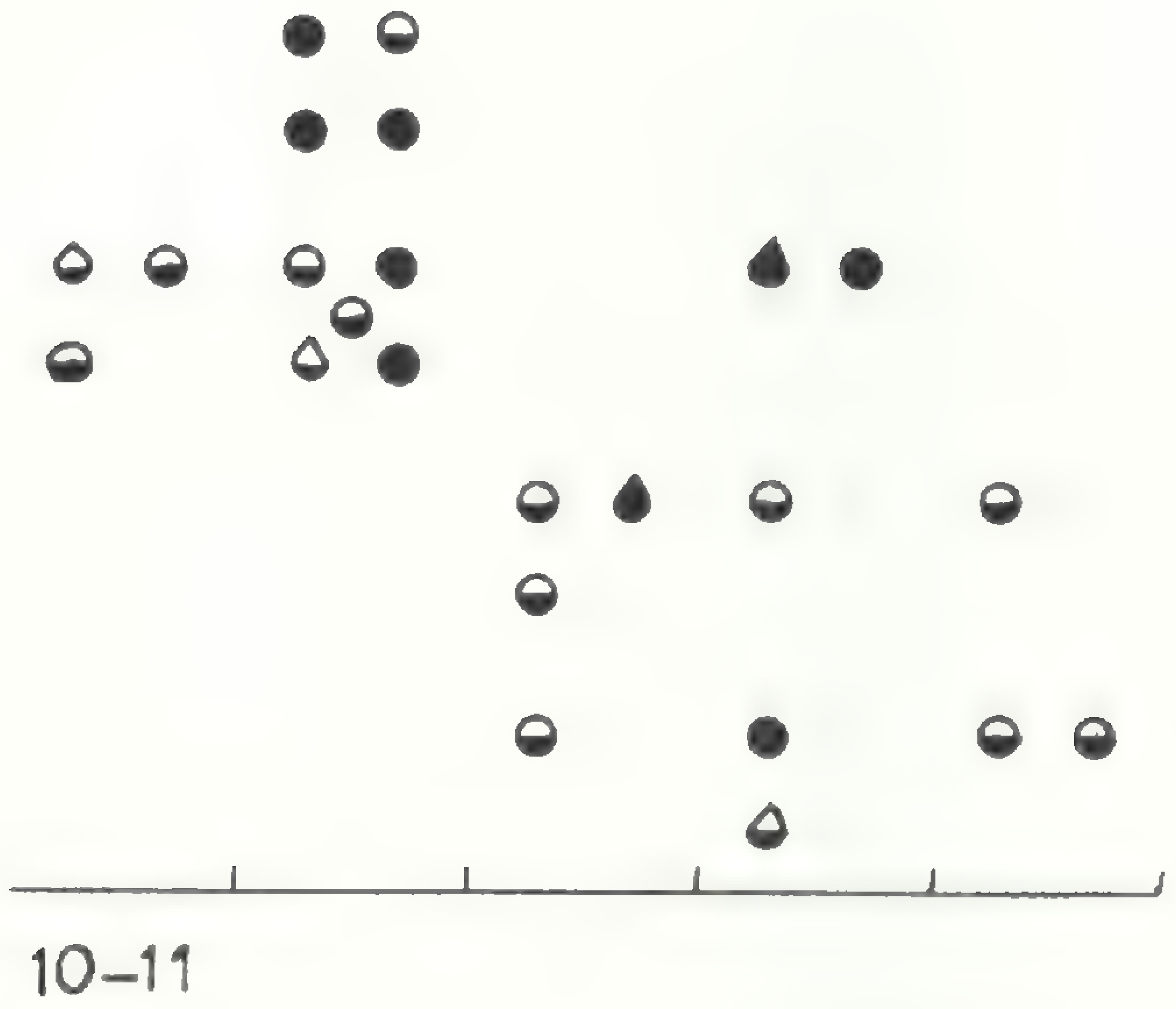
14. Tlajomulco, Jalisco. *Maíz criollo*

Tlajomulco is an ancient town of great importance in colonial times but now isolated from the railroad and the highway. Samples of maize from it are less likely to show the influence of modern varieties. Note that the extremely wide kernels have made it necessary to change thé scale as indicated in the diagram. This variety was prevailingly white, most of the ears showing a few yellow kernels. Two of the ears showed colored aleurone on one or two kernels *(pr)*. One ear showed a brilliant red flush (probably some allele of *R*).



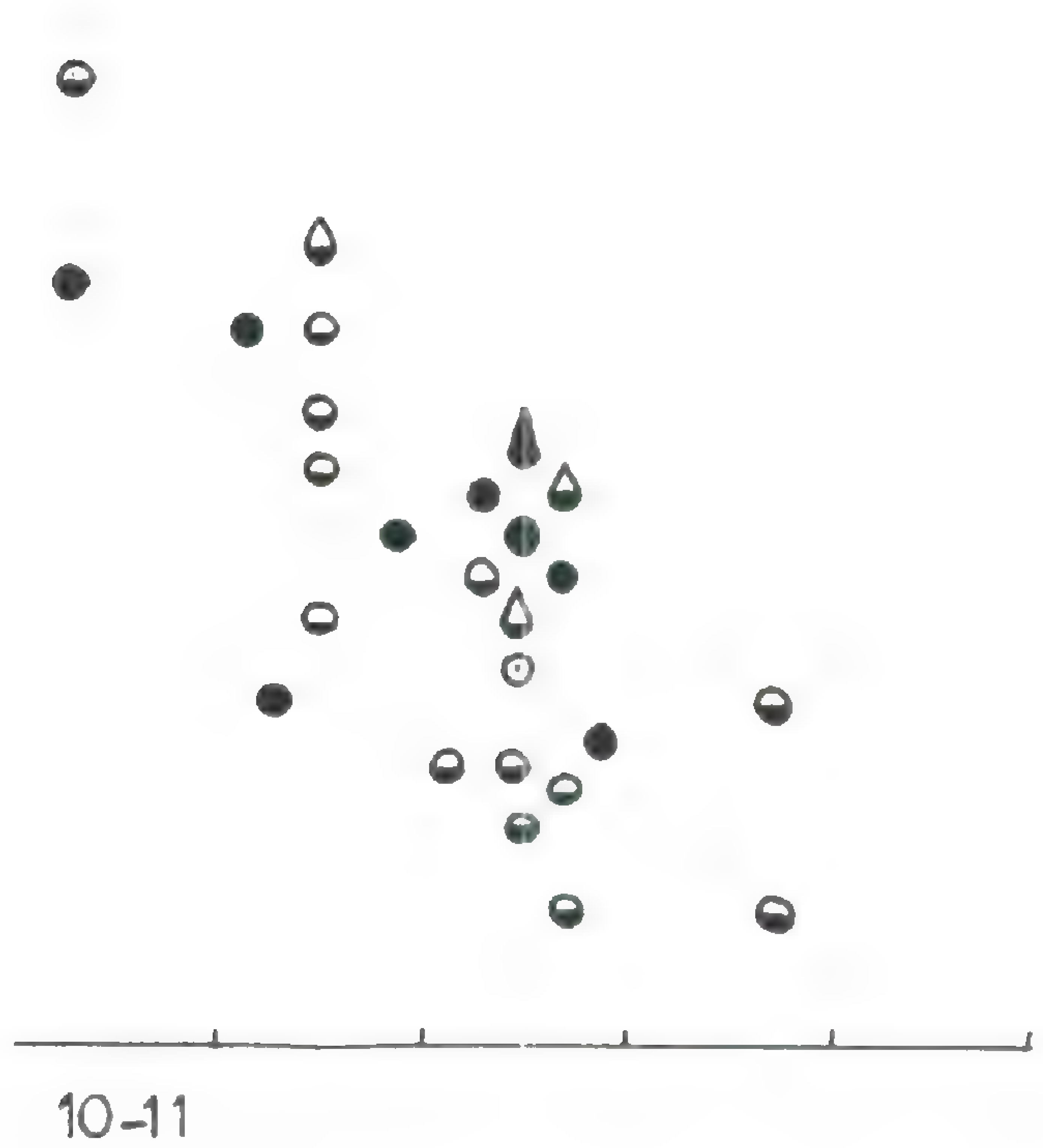
15. San Pedro, Tlaquepaque, Jalisco. *Maíz criollo*

From a little pottery-making town a few miles east of Guadalajara. Yellow and white with a few ears showing occasional kernels with colored aleurone. This variety was studied in the field when the plants were still fresh enough to show plant color. They had slight to strong color above the veins on the lower sheaths with slight to no interveinal color. The upper sheaths showed little color. Tassel branches varied from 5 to 24, with an average of 13. The male glumes were 10 to 14 mm., with an average of 12.



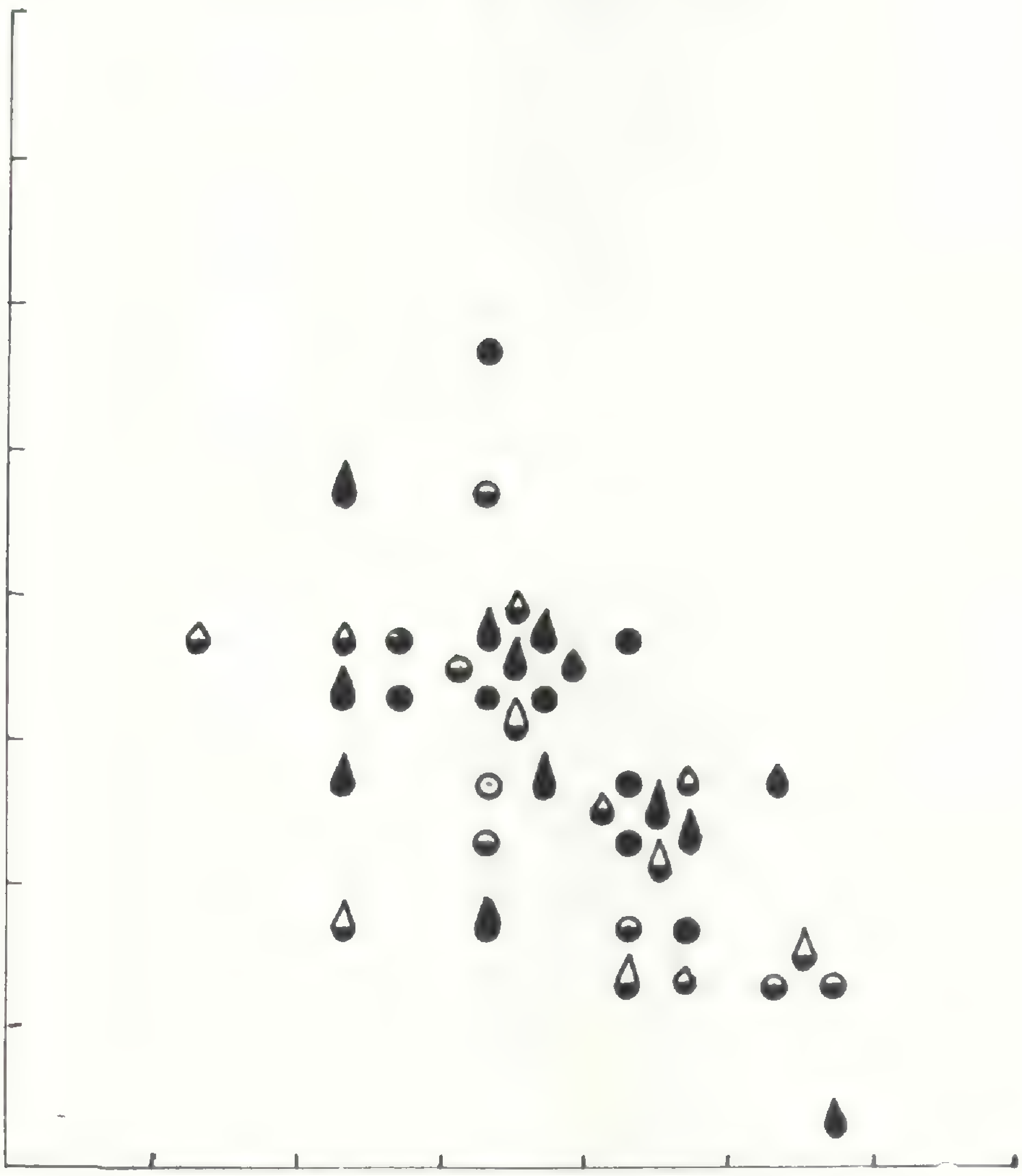
16. S. P. Tlaquepaque, Jalisco. *Maíz ancho*

Grown on a field which was better watered than the rest of the fields in town and therefore had a longer growing season. This and the next diagram are two selections from the same field made at husking time. In this one I accepted all the ears handed me by the workmen to avoid offending them. The second selection is strictly at random. Both selections are prevailingly white, with one all-yellow ear and a few yellow kernels on most of the ears. There was one ear with a crowned red pericarp *(P^{cr})*. The field was outstanding in uniting a high degree of productivity with great variability in type of ear. One extreme ear shown in fig. 8.



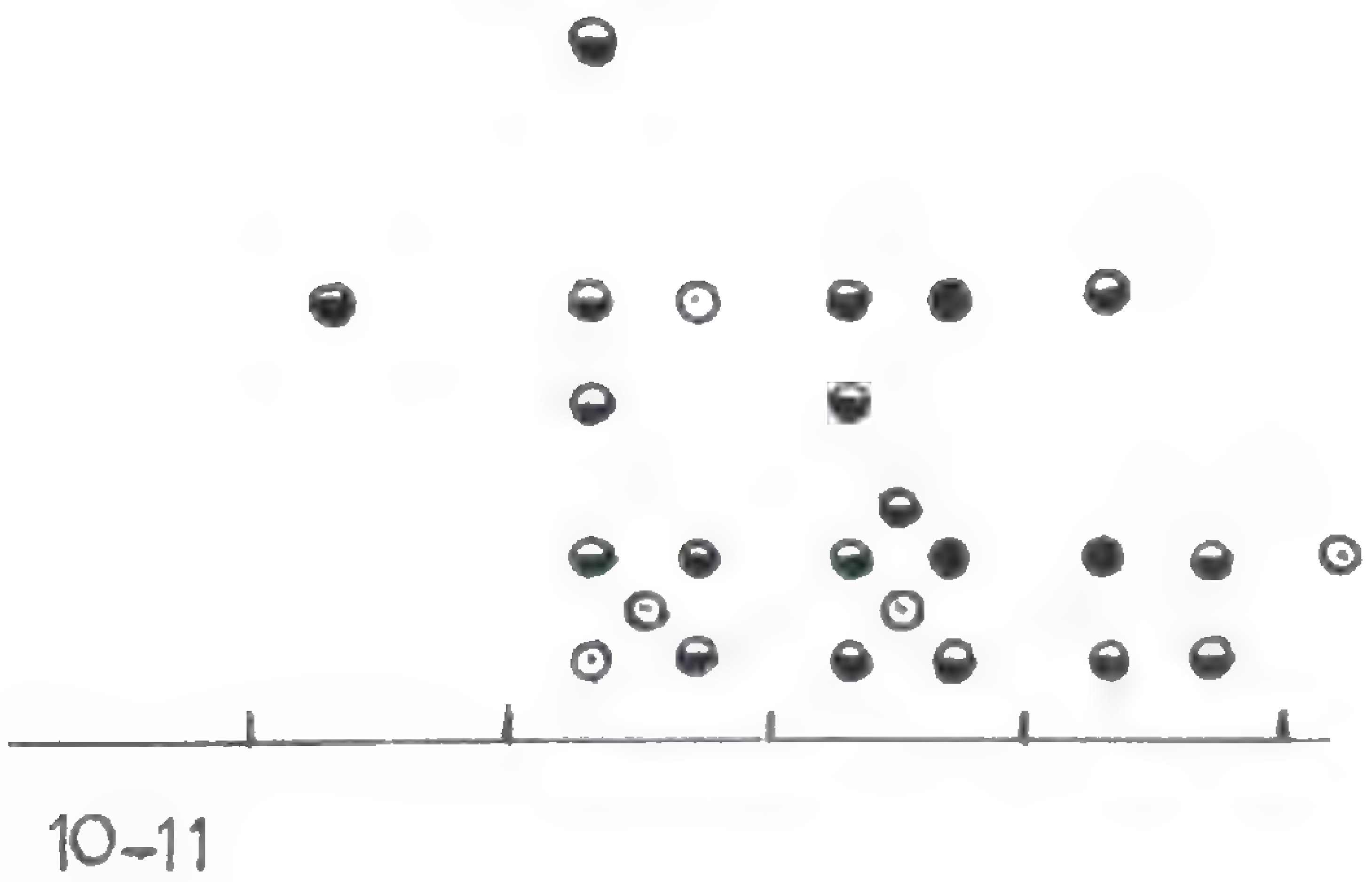
17. S. P. Tlaquepaque, Jalisco. *Maíz ancho*

A second sample from the same field; see the previous account. Extremely variable and productive. This photograph is not to the same scale as the others in the Appendix.



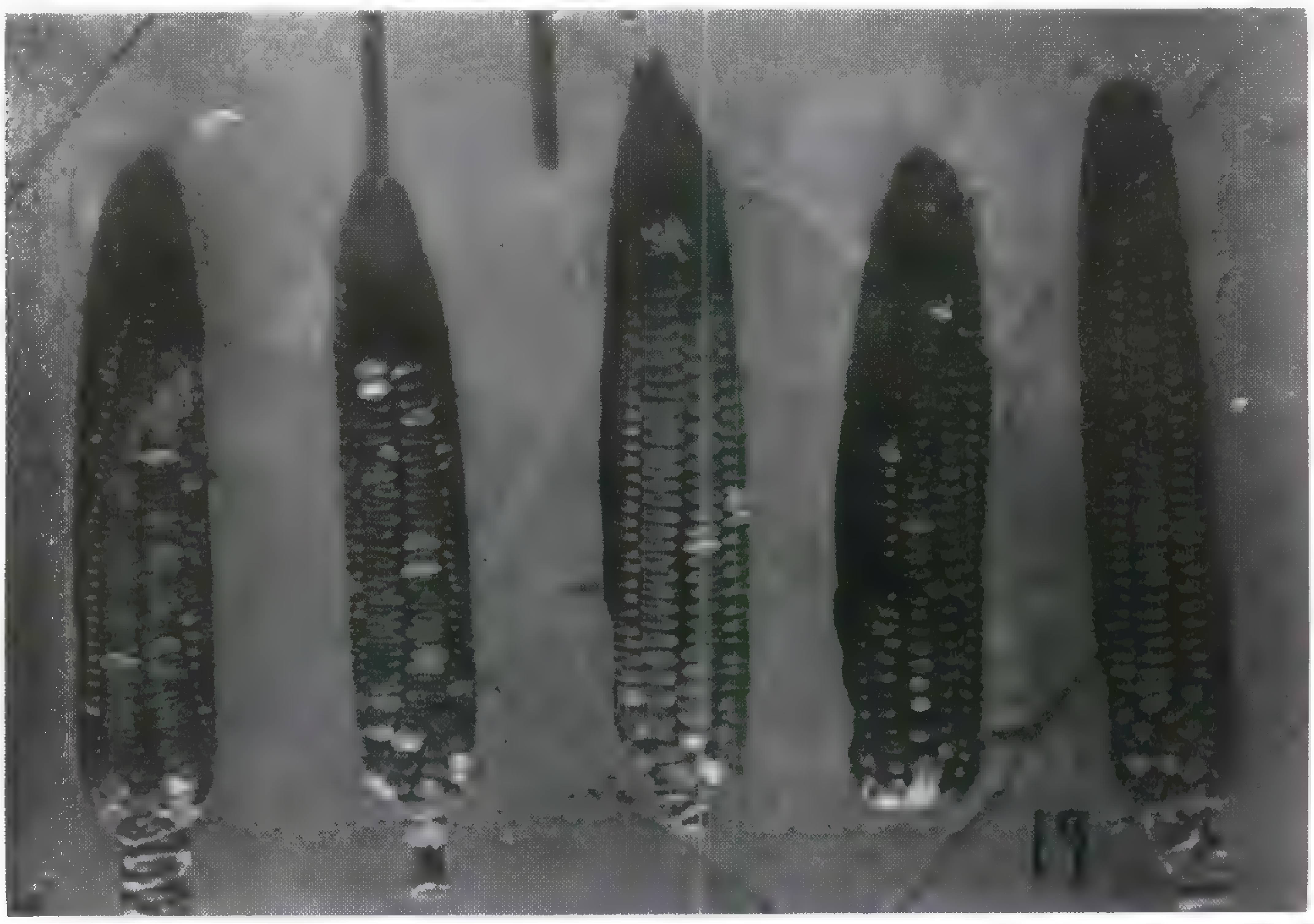
18. S. P. Tlaquepaque, Jalisco. *Maíz chino*

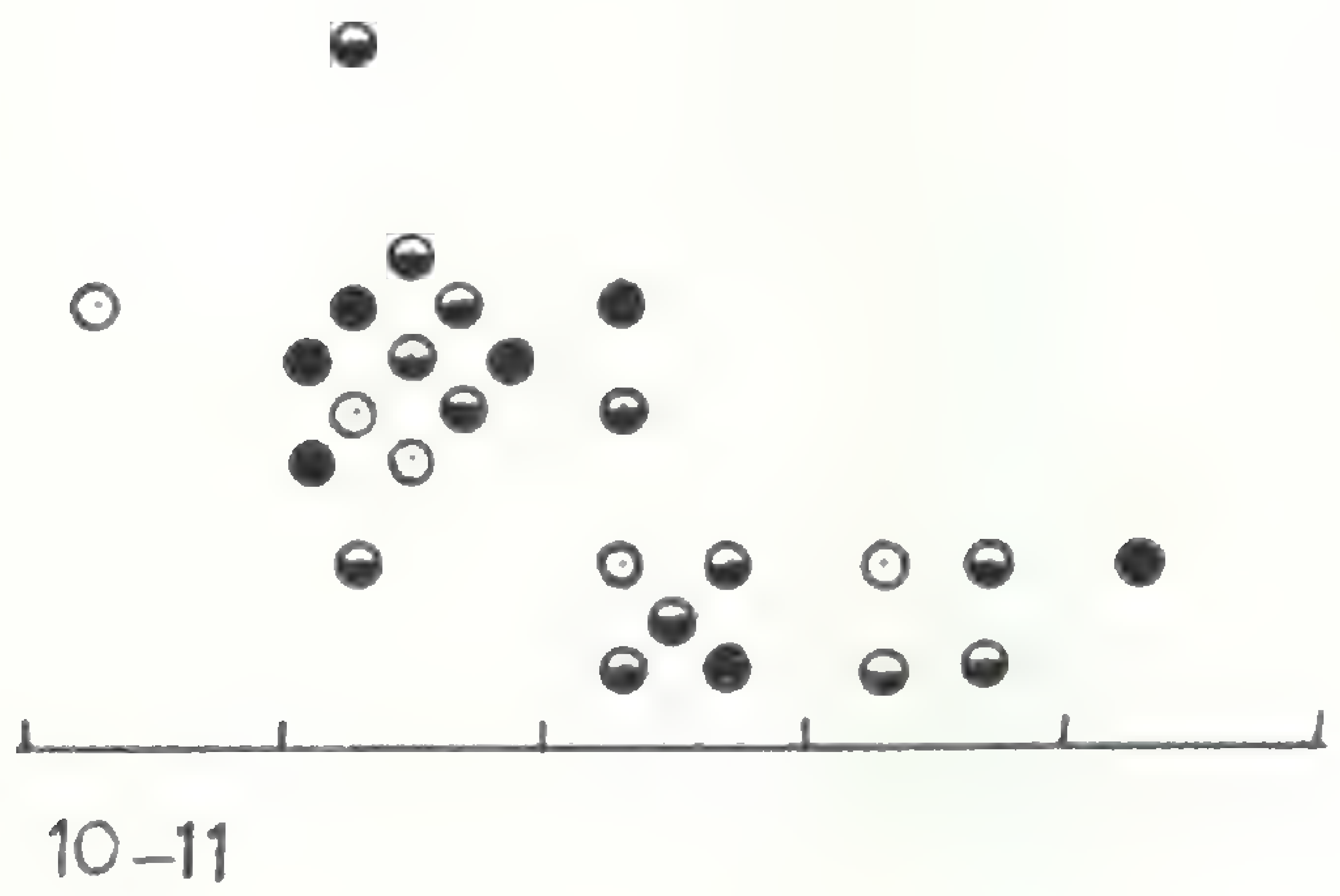
Prevailingly white. *Maíz colorado (pr)* was planted at the end of the field. Cross pollinations indicate this variety is mostly *Pr*, C^i. Sample of 40 ears.



19. S. P. Tlaquepaque, Jalisco. *Maíz colorado y maíz negro*

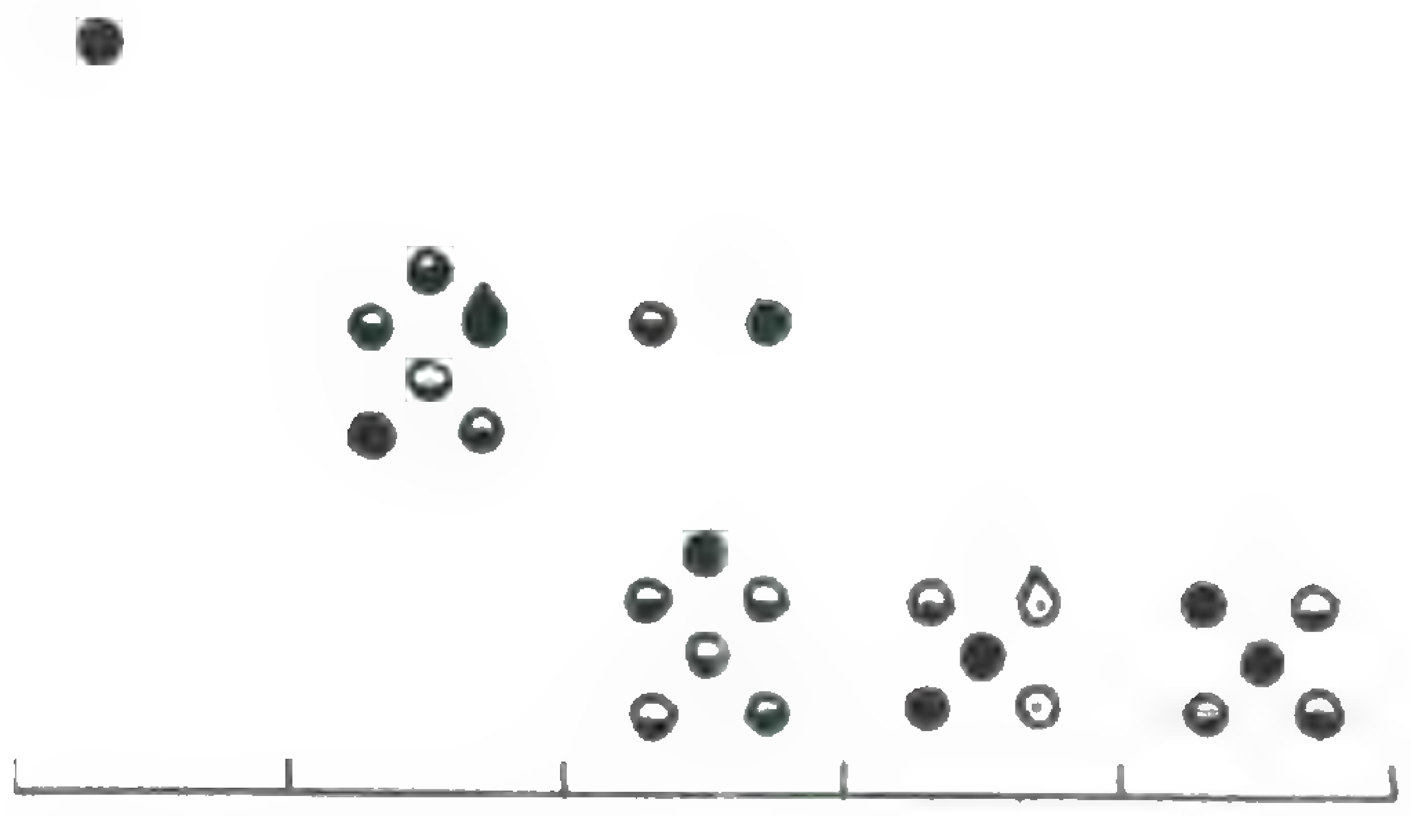
A badly mixed field of "elote" corn grown by a poor widow. Note that the scale has been changed because of the wide kernels.





20. S. P. Tlaquepaque, Jalisco. *Maíz criollo*

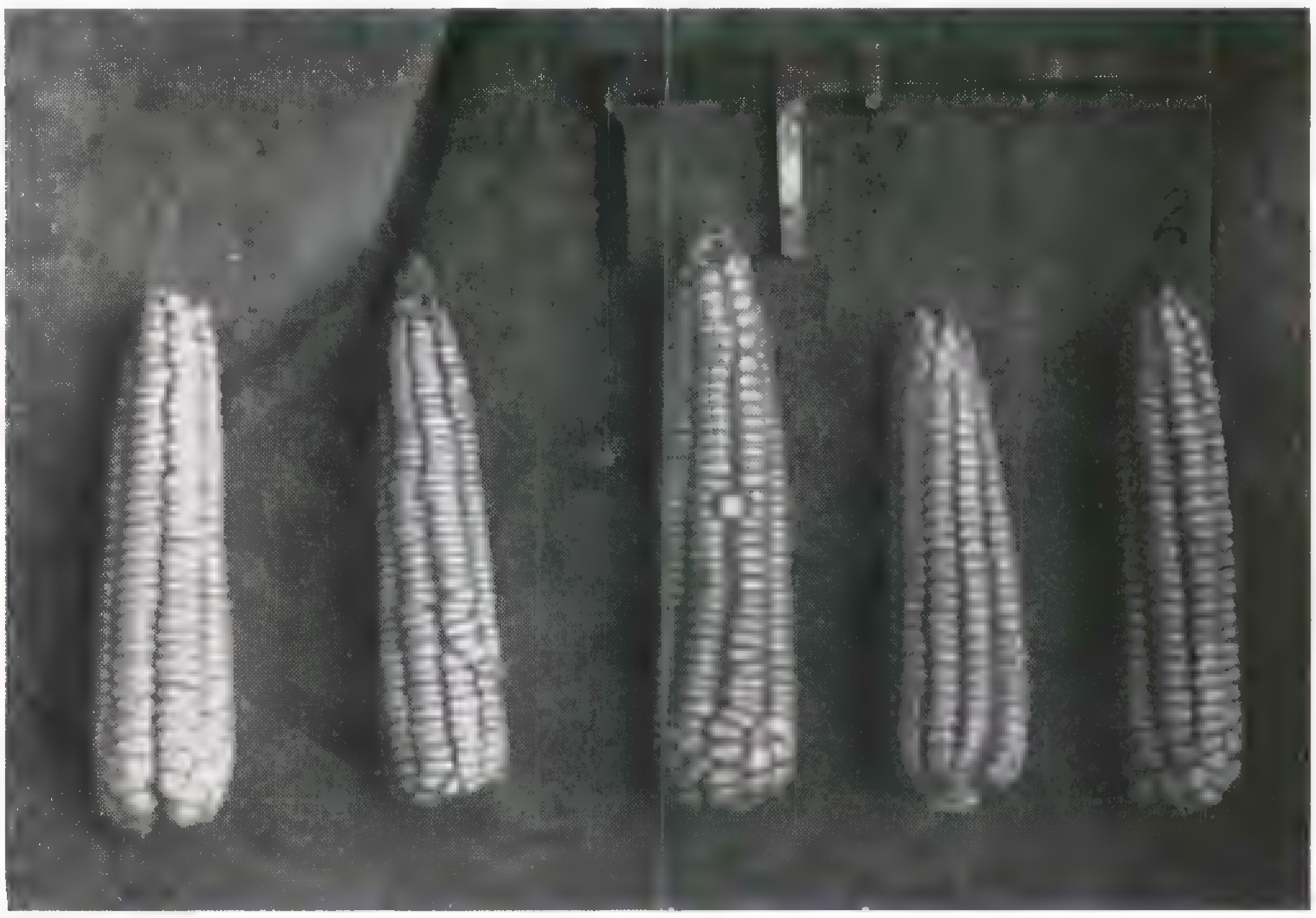
Prevailingly white. Half of the ears showed a few yellow kernels. Two of the ears had faintly colored aleurone *(pr)*. One ear had faint pericarp color *(P^{cr})*.

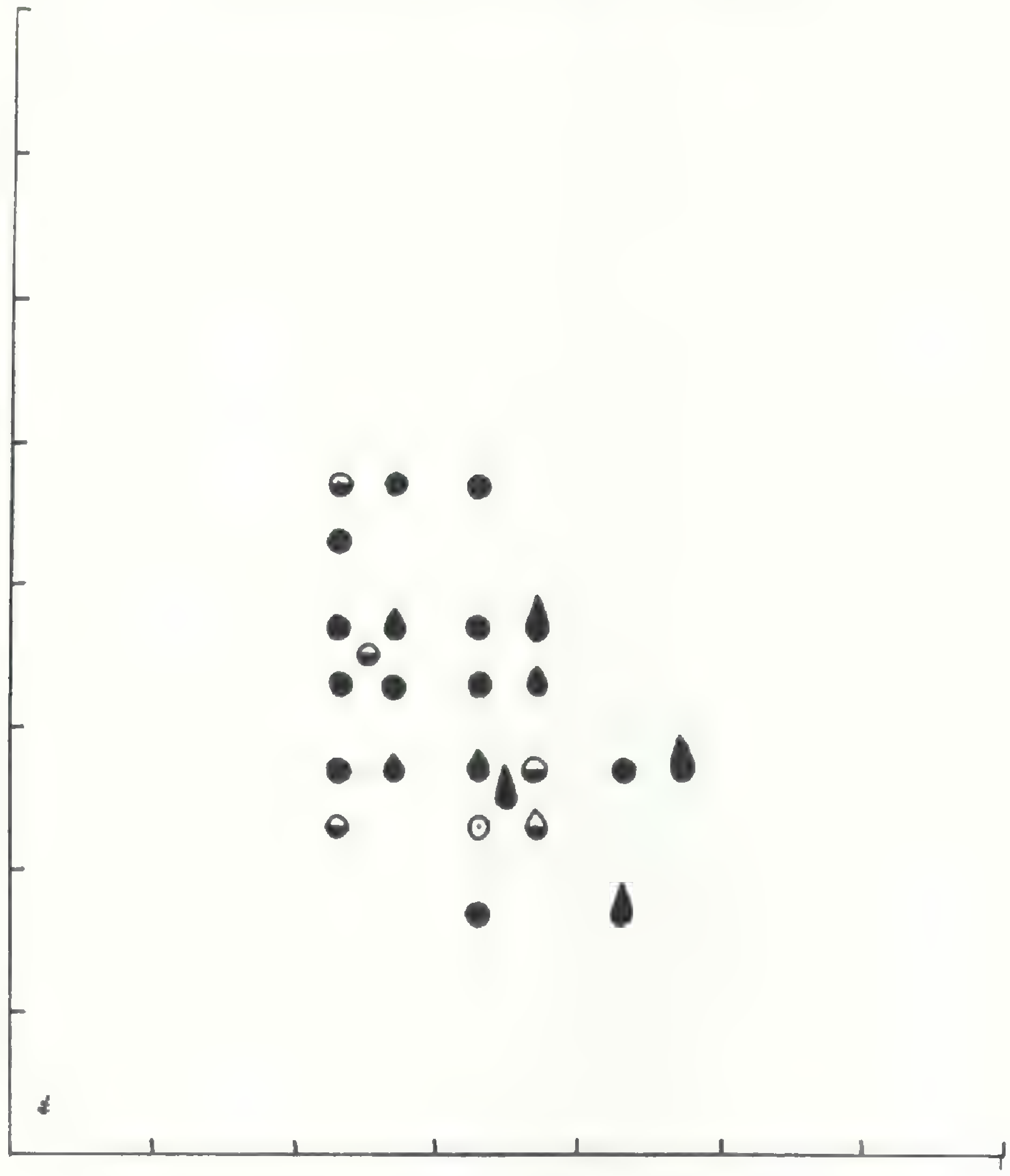


10–11

21. Tonolá, Jalisco. *Maíz criollo*

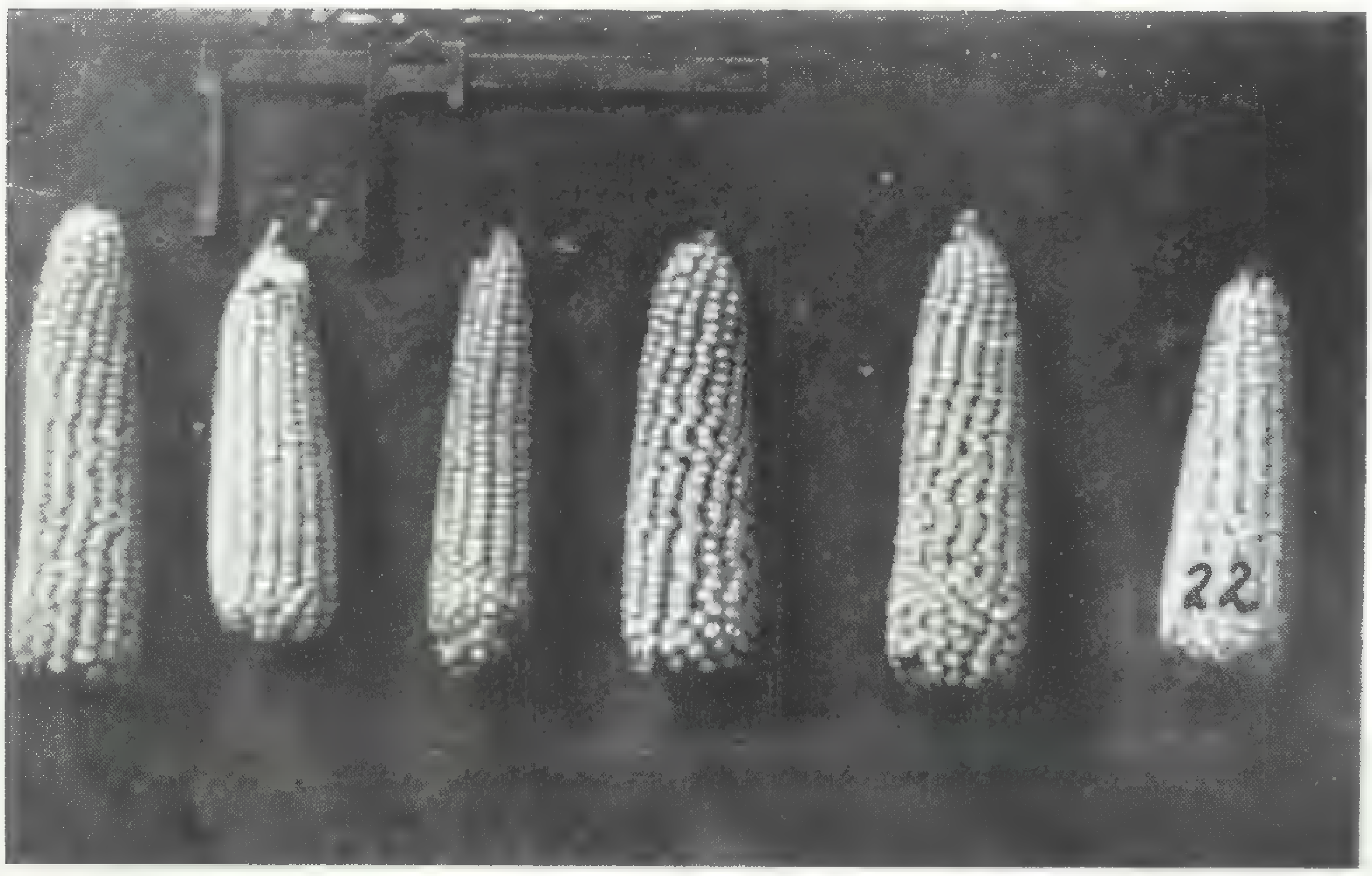
Tonolá is a still more remote pottery town near Guadalajara. Prevailingly white with few to many yellow kernels. A few *Pr* kernels.

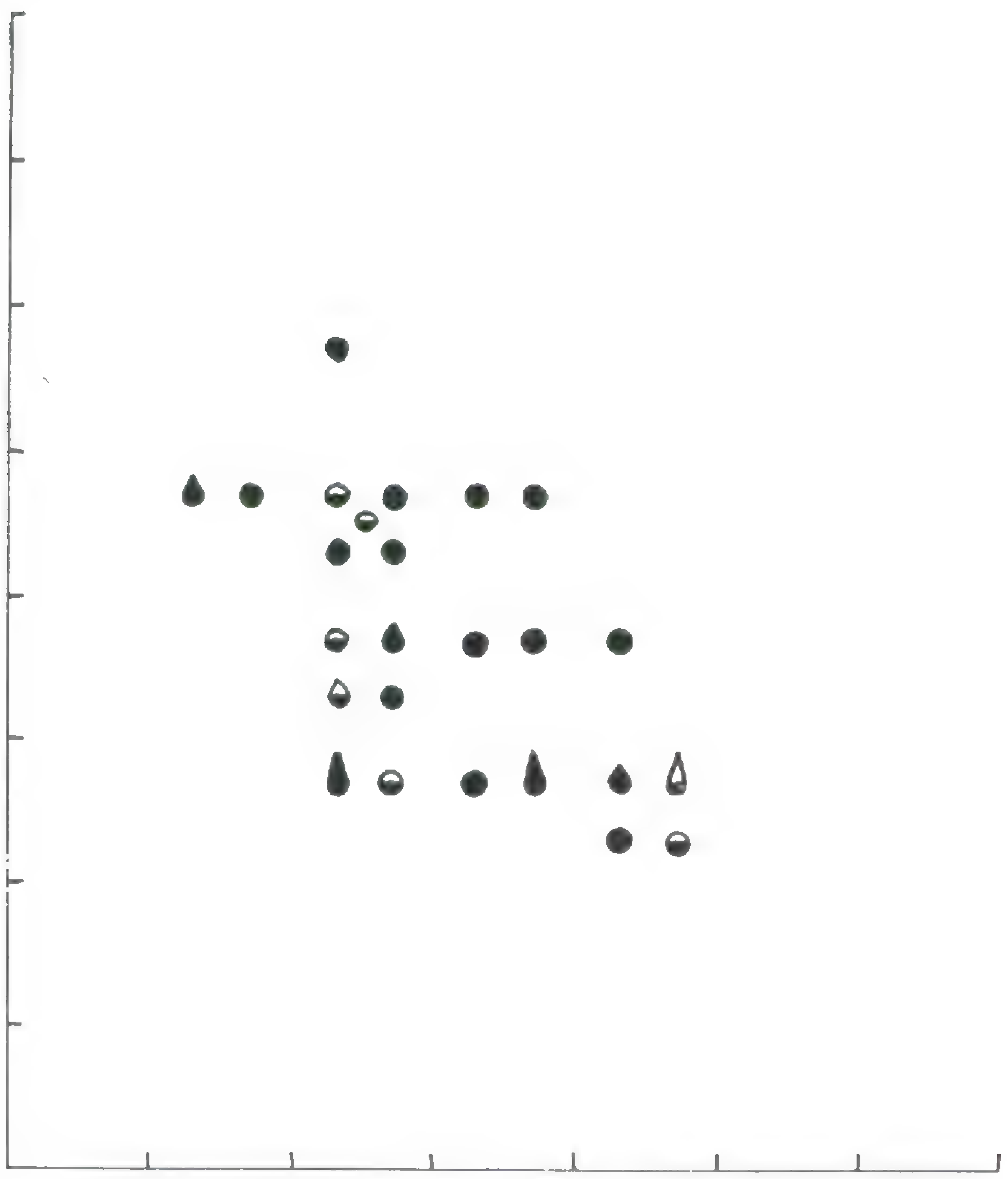




22. Tepatitlán, Jalisco. *Maíz valenciana*

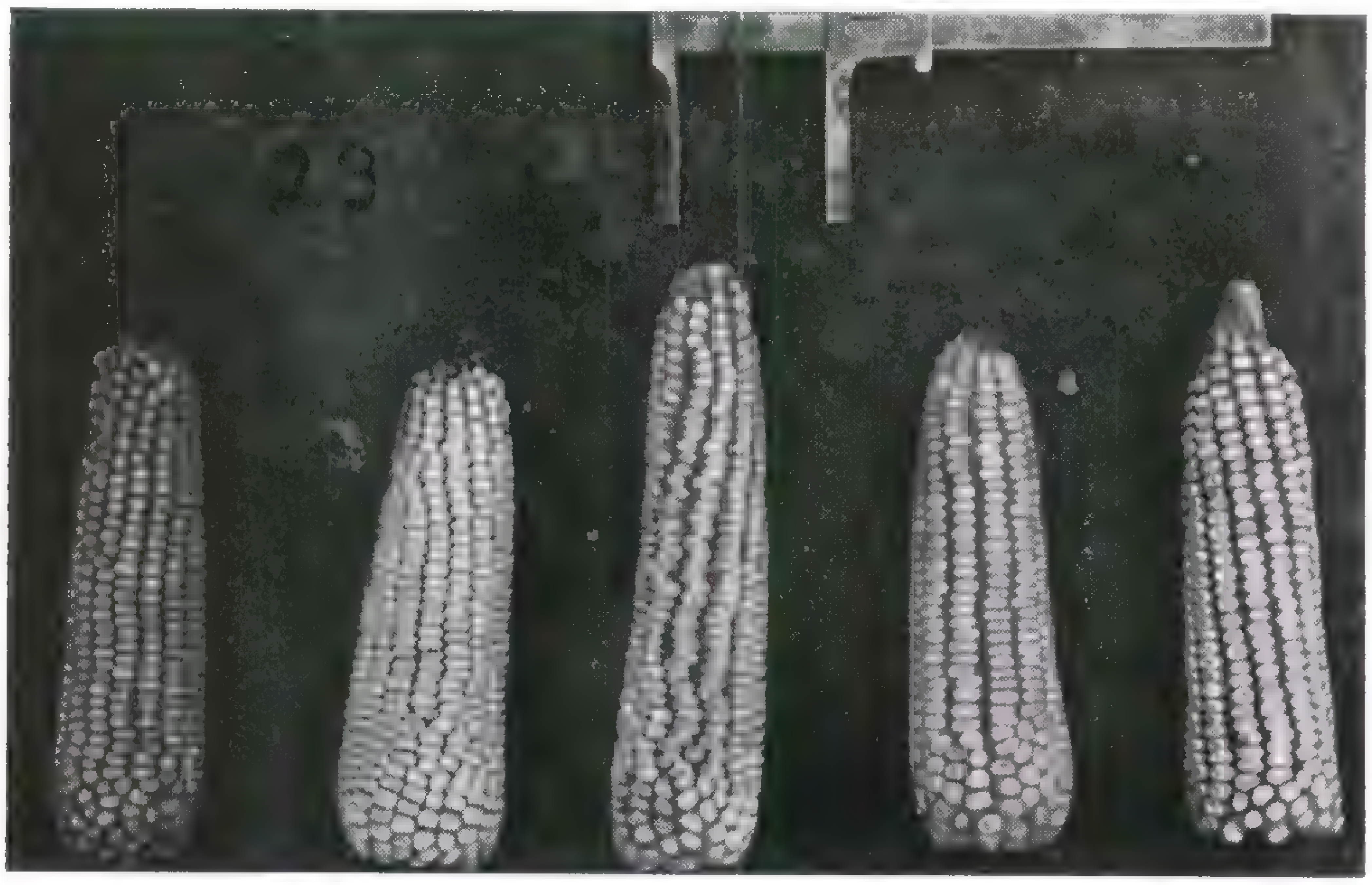
On sale in the local market. Prevailingly yellow, many white kernels and a few colored aleurone *(Pr)*.

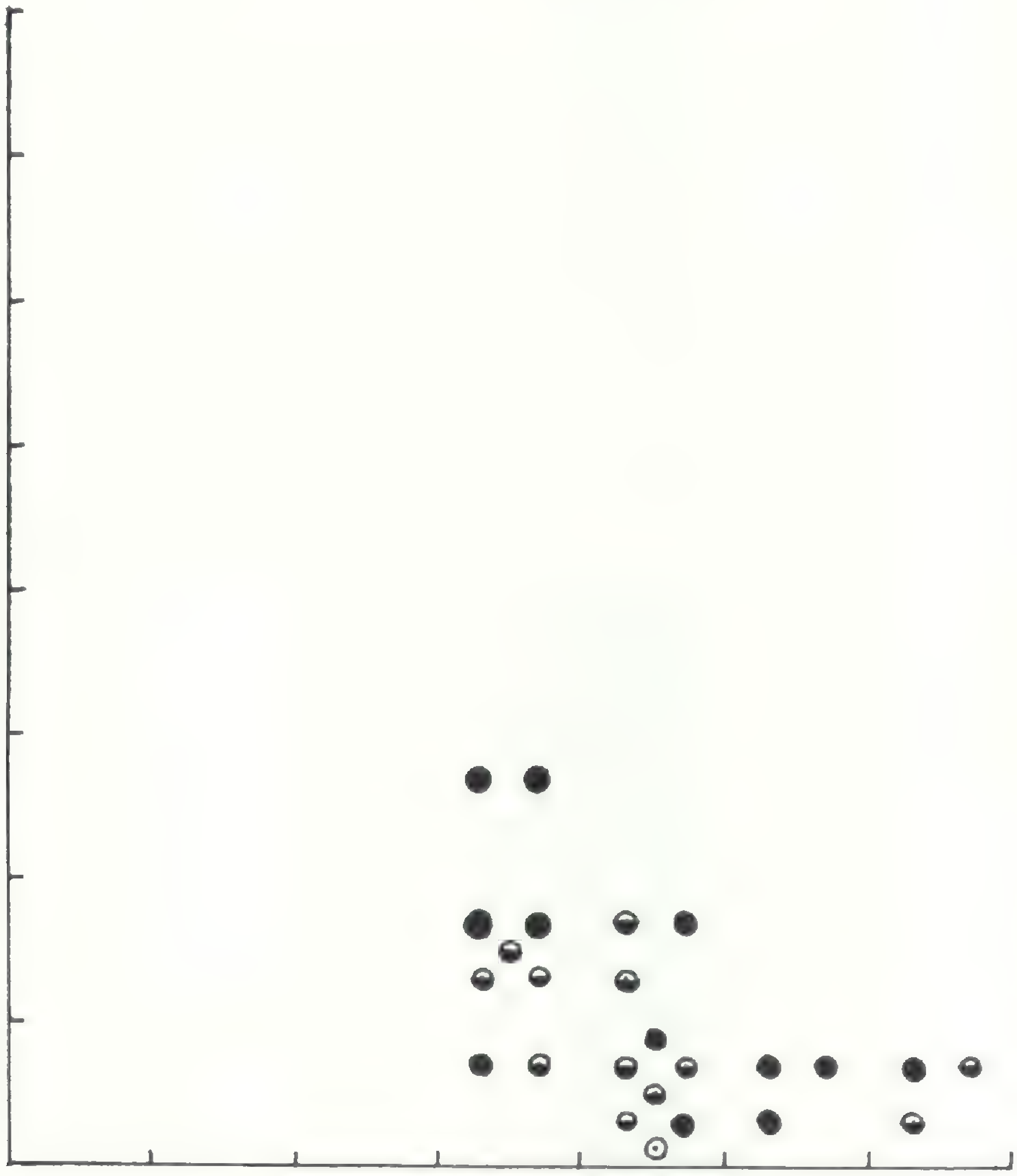




23. Tepatitlán, Jalisco. *Maíz amarillo*

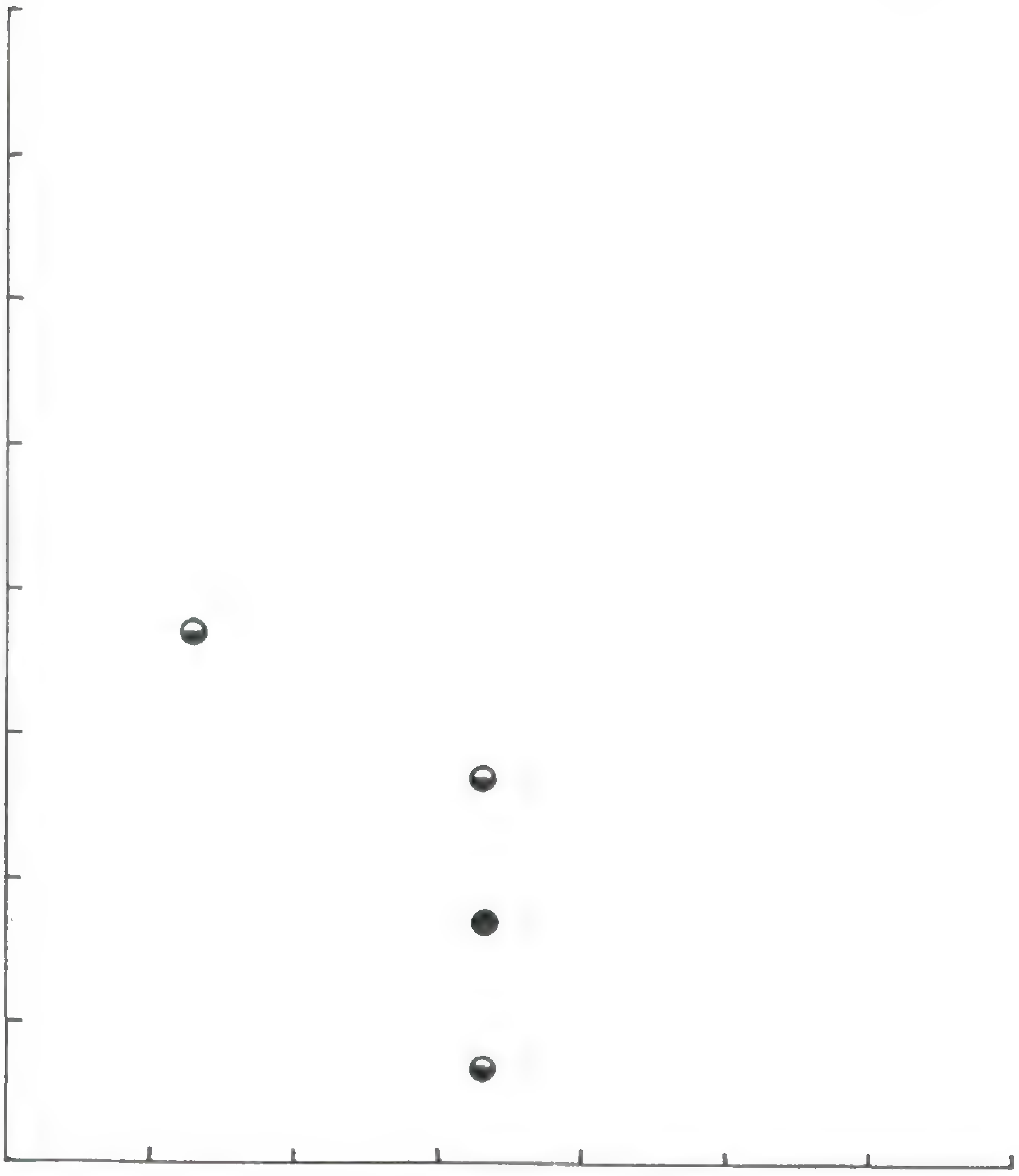
Prevailingly yellow. A minority of the ears with white kernels. Four ears had kernels with colored aleurone *(Pr)*, two ears $P^{r}r$.





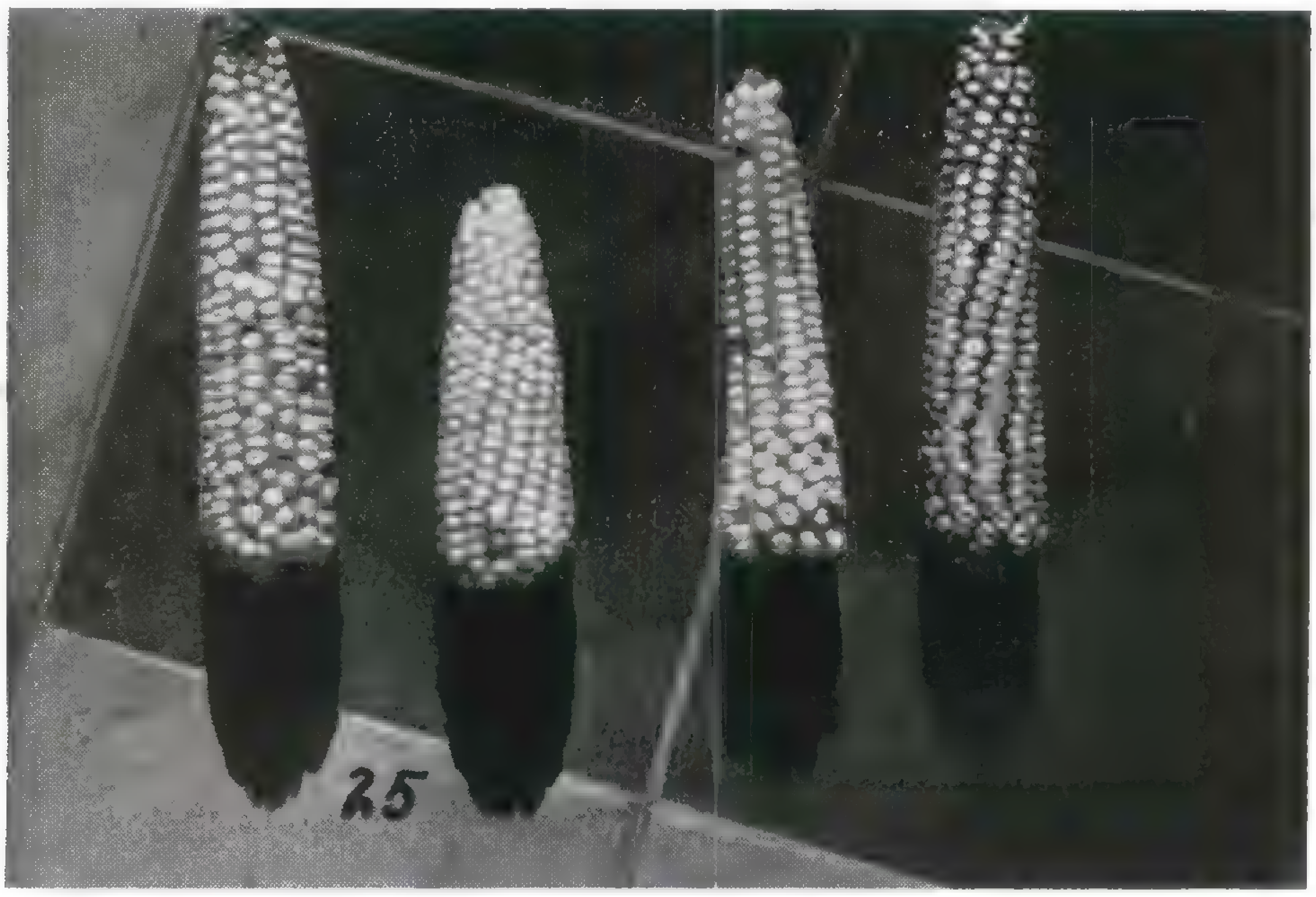
24. Tepatitlán, Jalisco. *Maíz blanco*

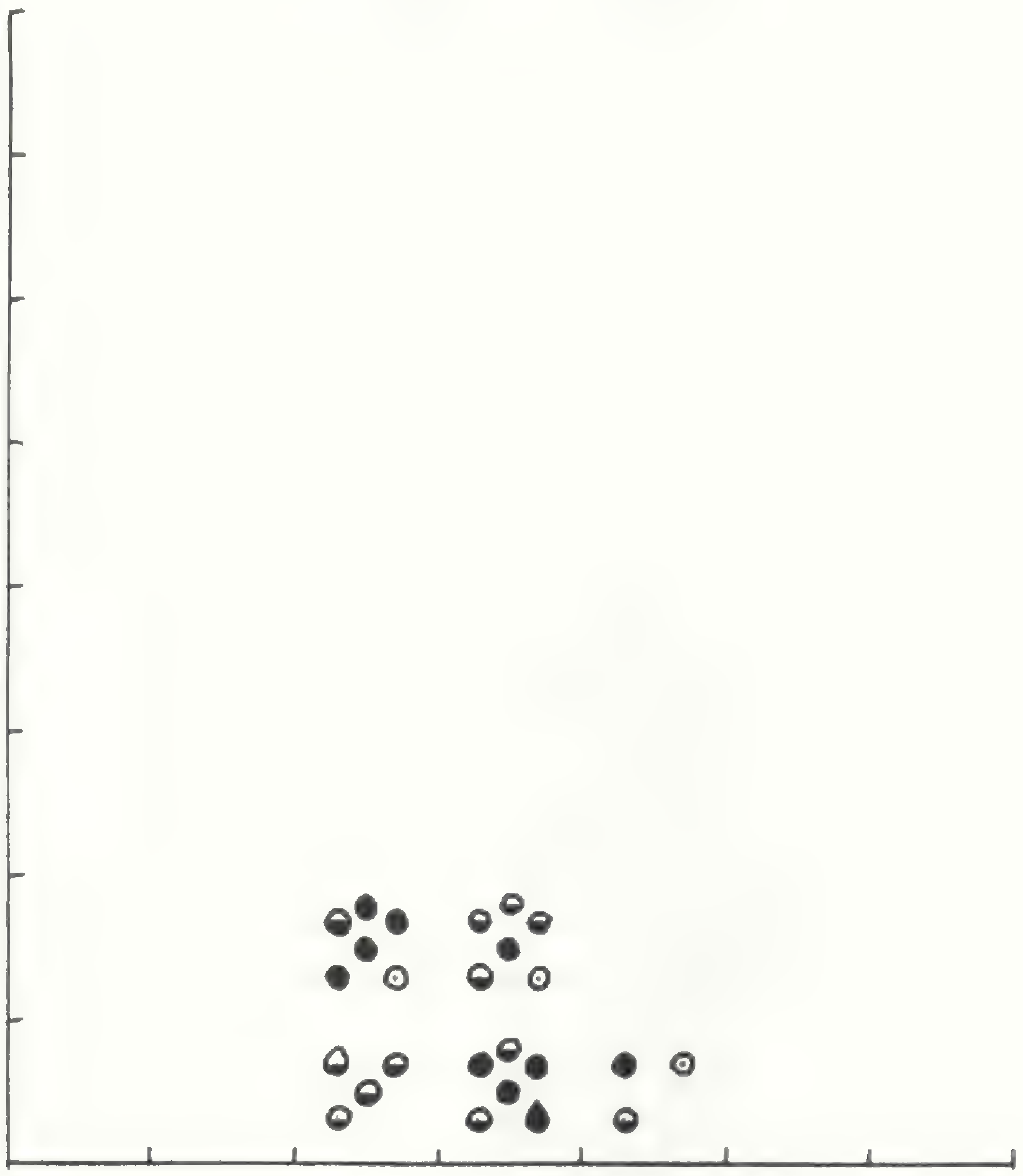
From the same small farm as the preceding variety. Prevailingly white, a minority of the ears with yellow kernels. Grown in an adjoining field to the preceding.



25. Apango, Jalisco. *Maíz amarillo*

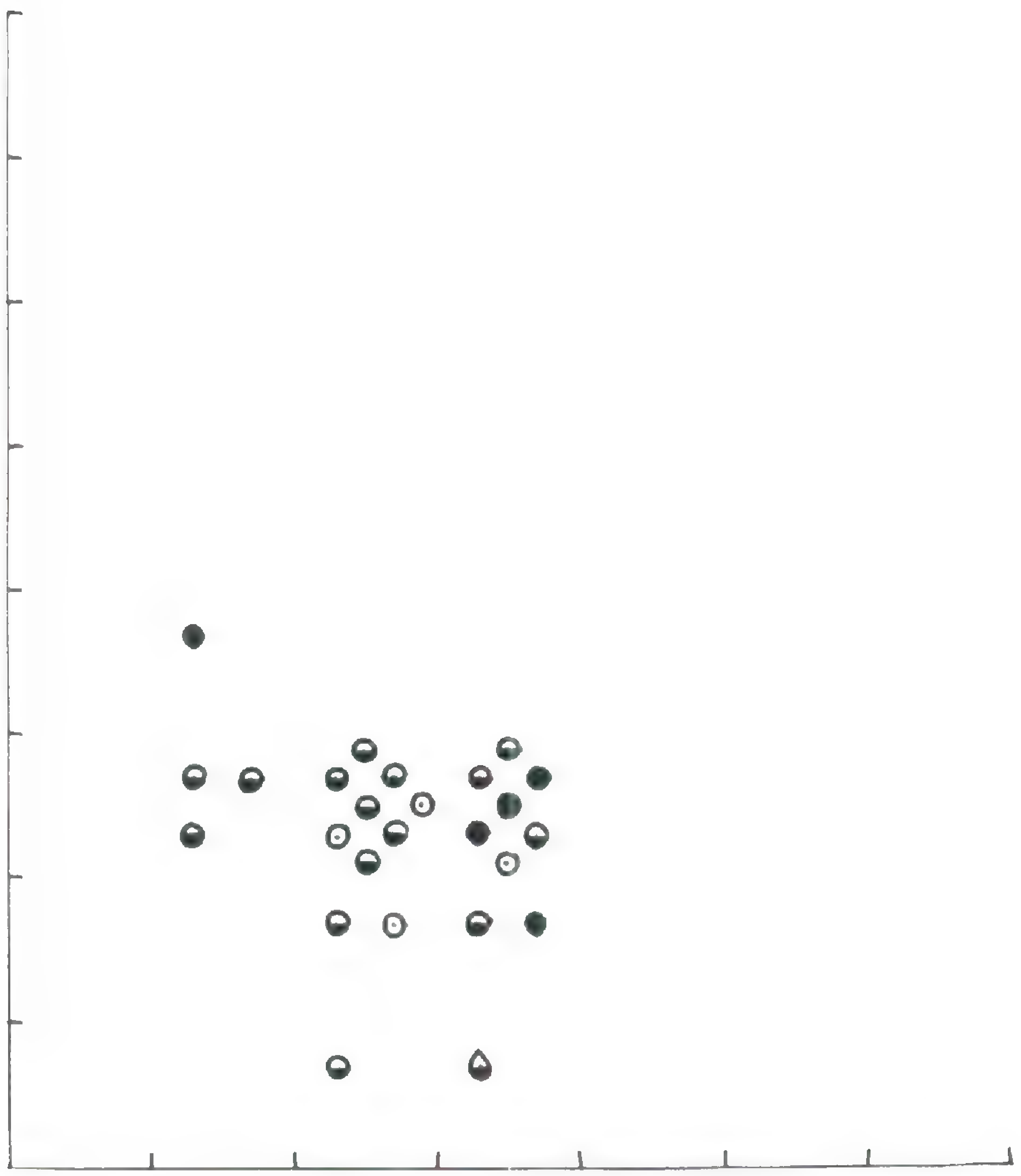
Apango is a tiny town on the north flank of the Volcán de Colima. The ears were selected from a field and represent the extremes. Yellow; one ear strongly colored crown pericarp (P^{cr}).





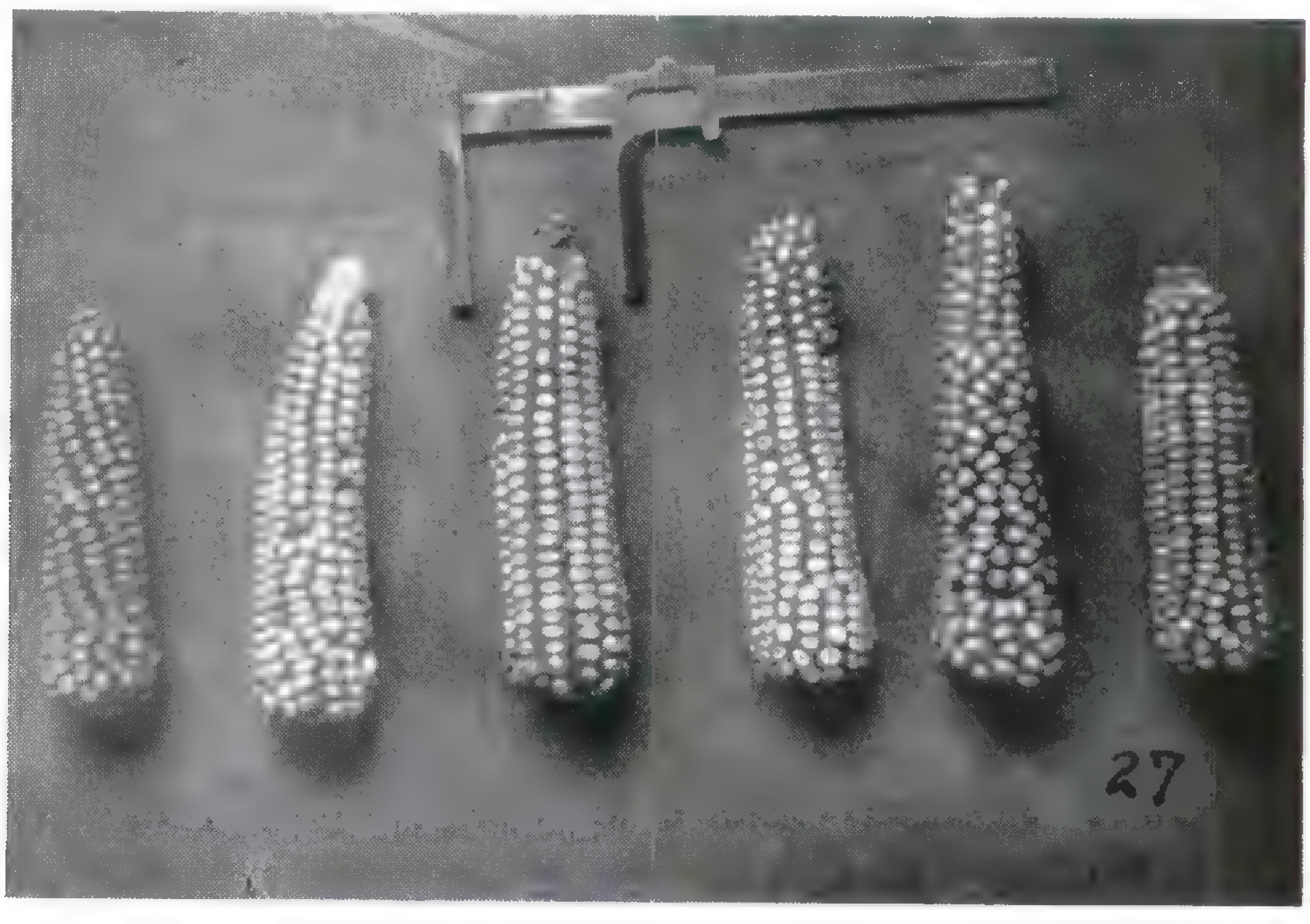
26. Tapalpa, Jalisco. *Maíz amarillo*

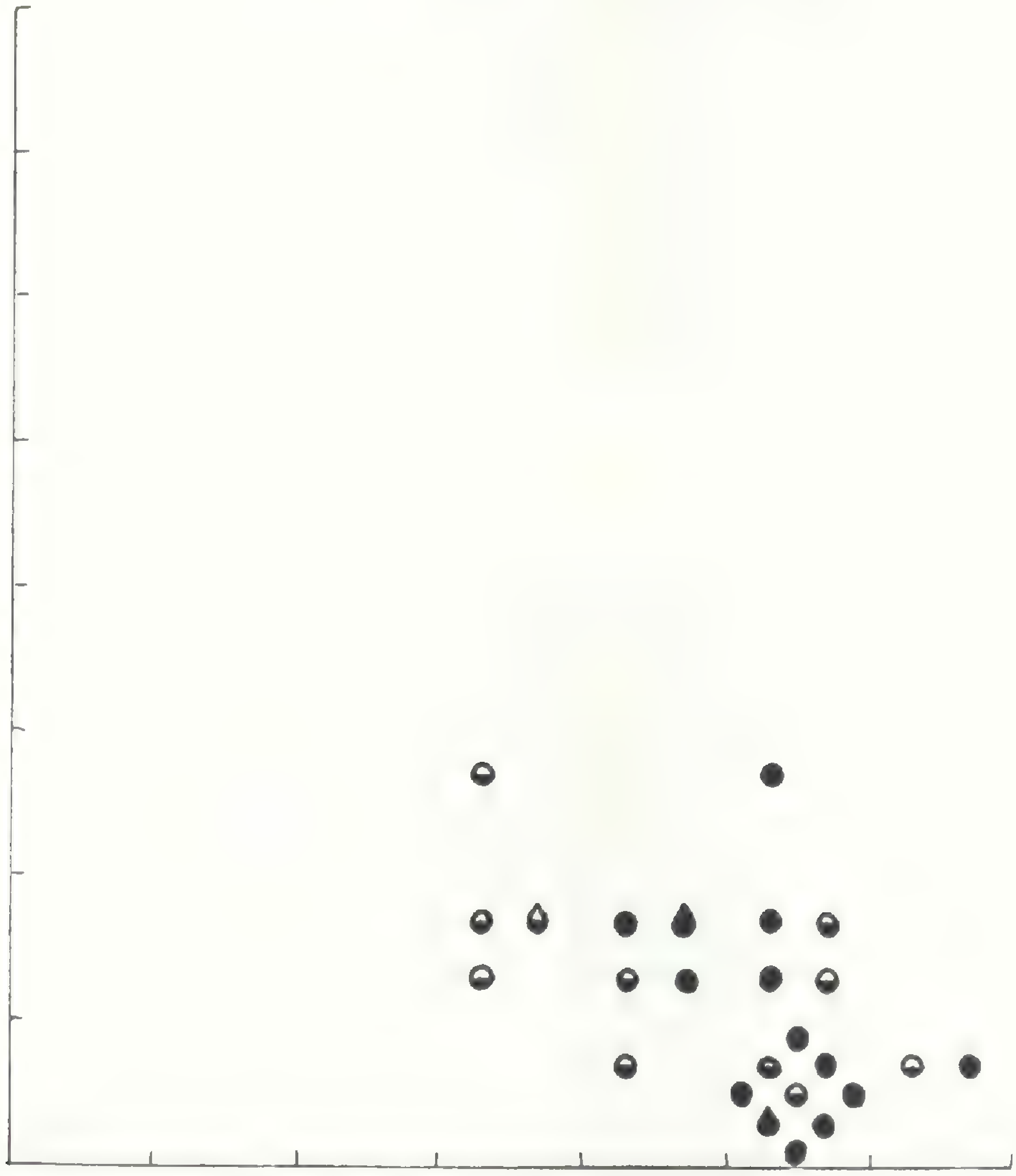
Tapalpa is a large and handsome town in the middle of a small, fertile, isolated plateau on the north flank of the Volcán de Colima. This variety was prevailingly yellow with many white kernels. Six of the ears had colored pericarp of some shade or other (various alleles of *P* and P^{cr}). Seven had red cobs.



27. Tapalpa, Jalisco. *Maíz amarillo del cerro*

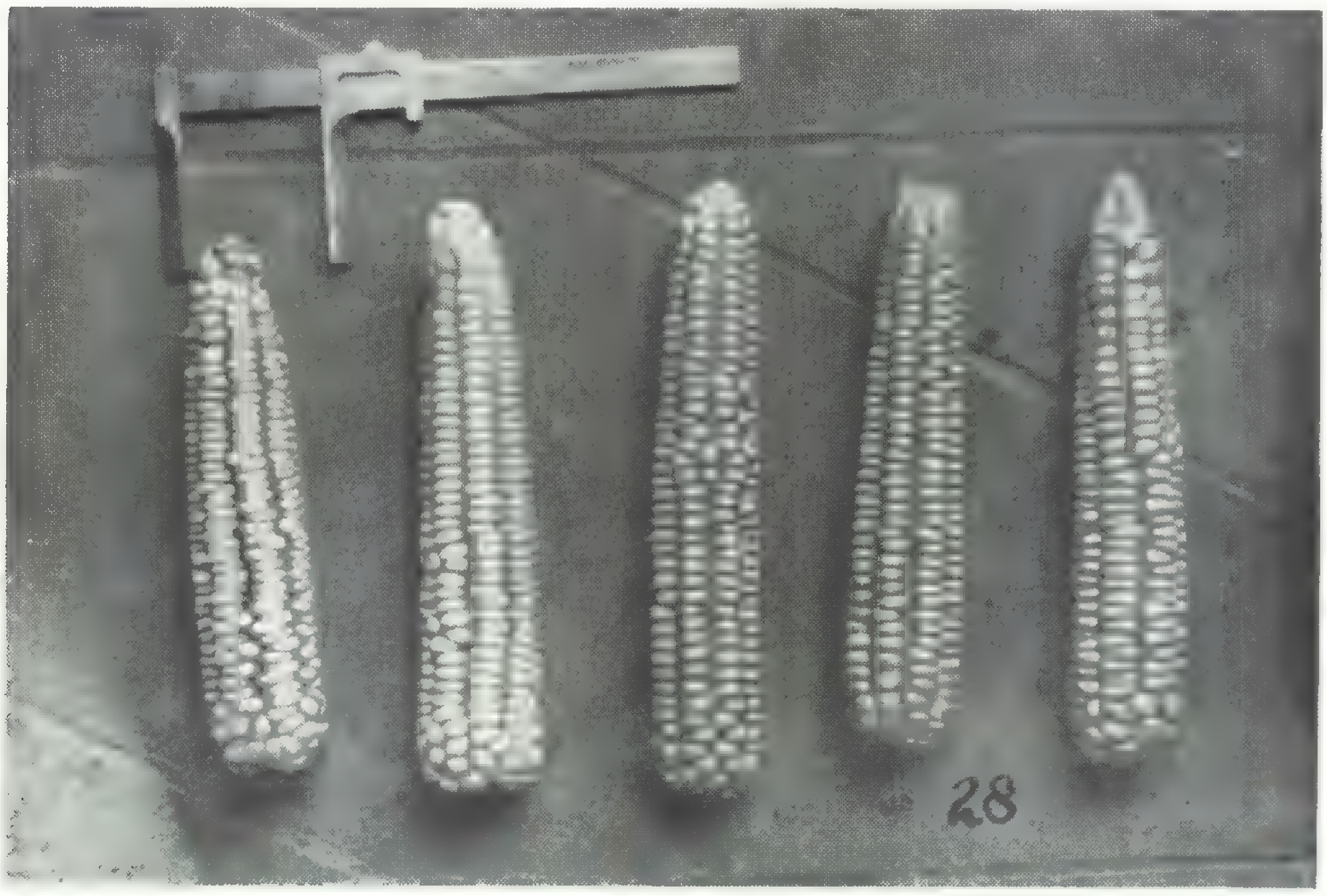
Prevailingly yellow with many white kernels. The majority of the ears have colored pericarp (P and P^{cr}) of various intensities.

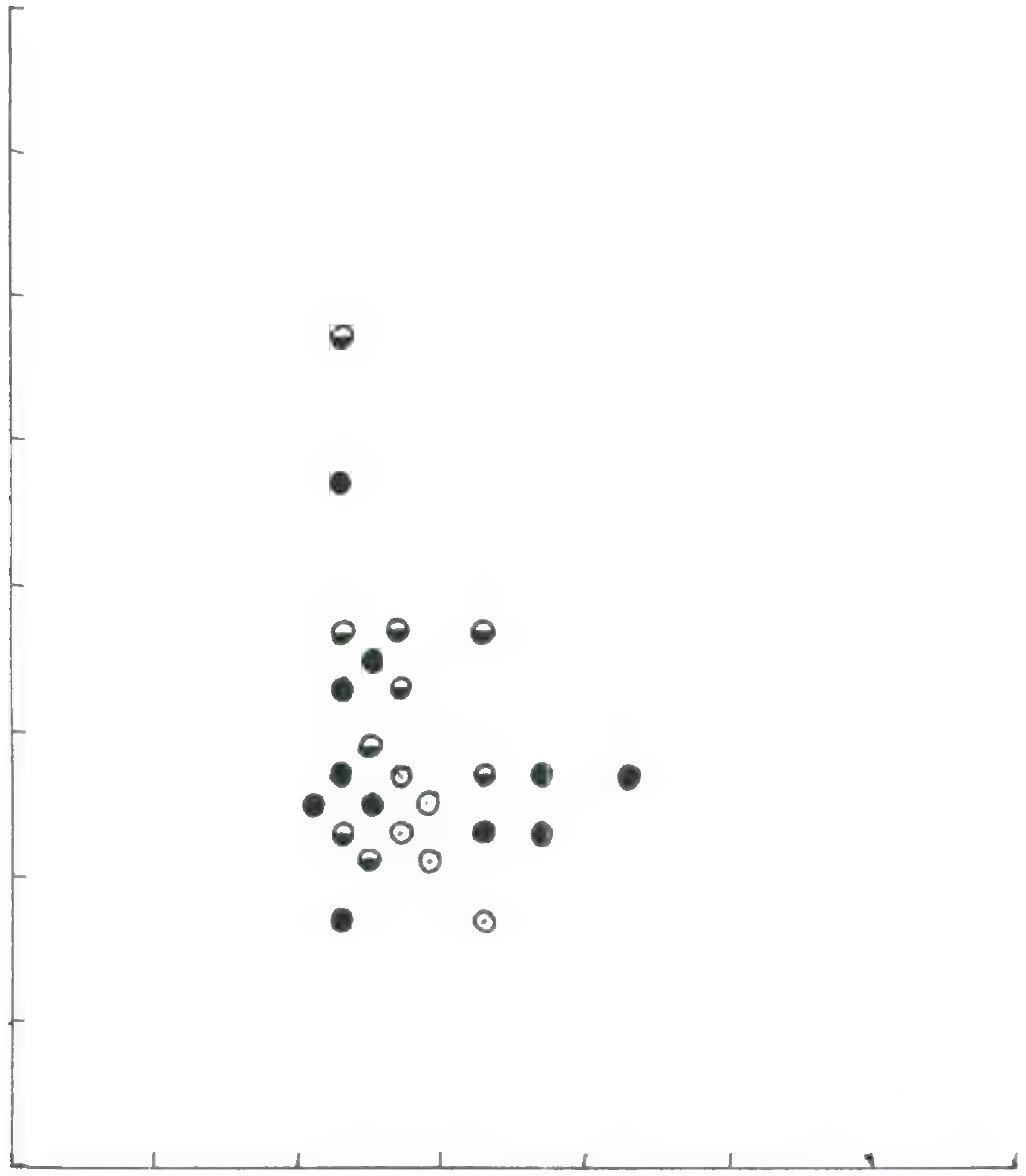




28. Tapalpa, Jalisco. *Maíz amarillo de tierra más templada*

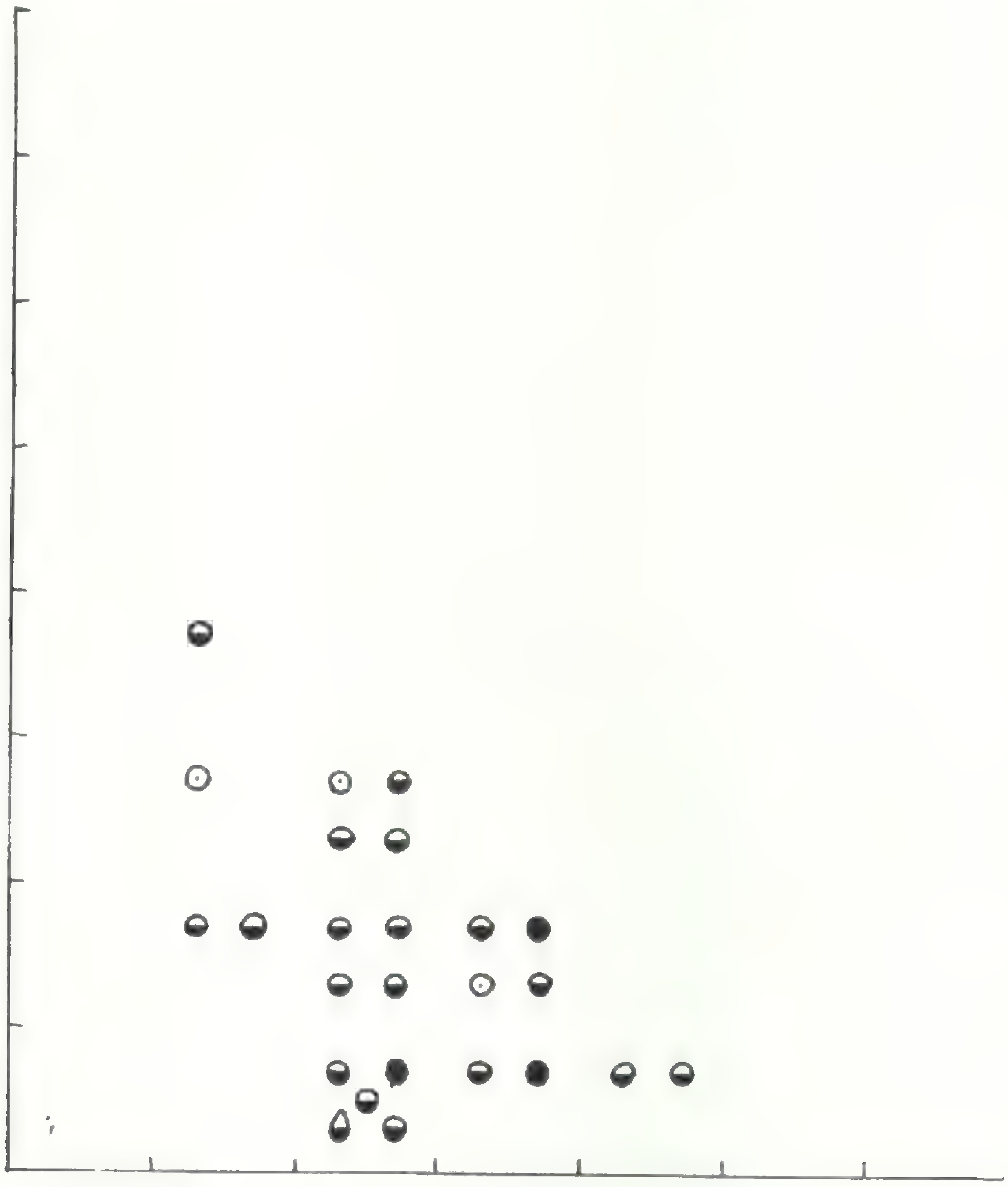
As the name indicates, grown on fields well below the town, hence with a longer season. Light yellow and white, mostly red-cobbed.





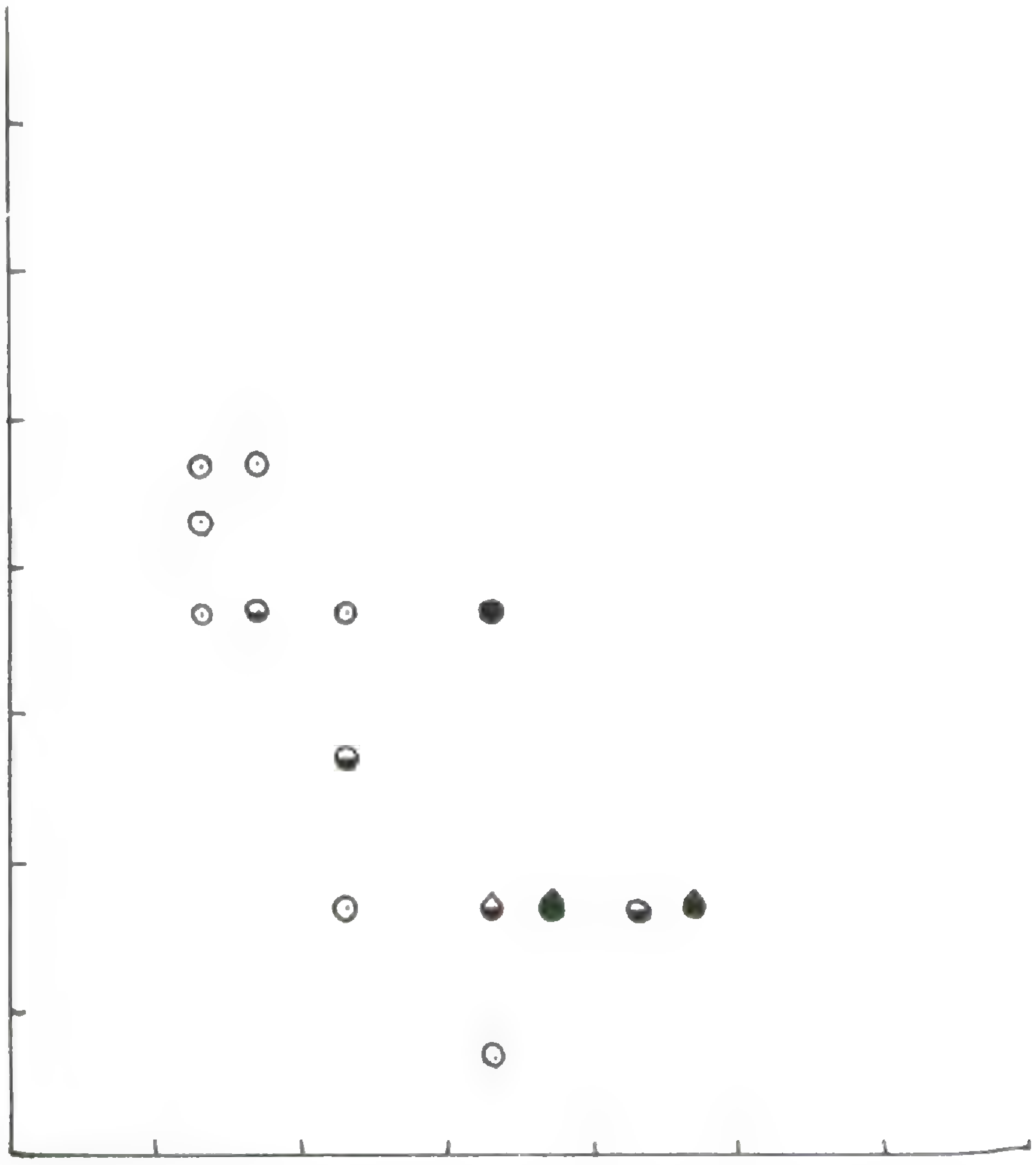
29. Tapalpa, Jalisco. *Maíz criollo blanco*

White, a few of the ears with a few bright yellow kernels. One ear *Pcr*.



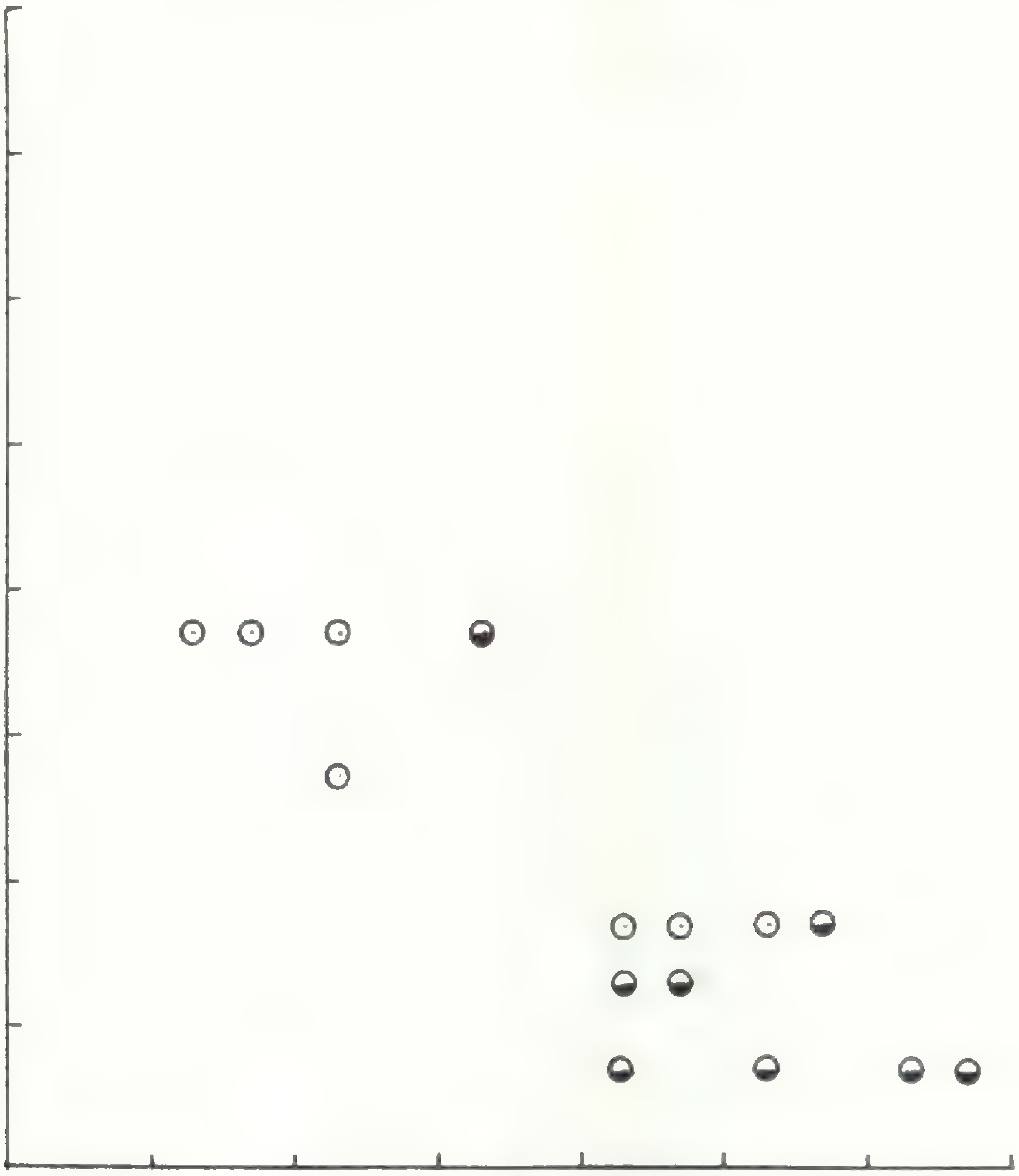
30. Tapalpa, Jalisco. *Maíz espiga blanca*

Unlike most of the preceding varieties, this one does not have a brightly colored tassel. Prevailingly yellow, a few of the ears with white kernels and a few with colored pericarp (*P* and P^{cr}). Cobs white or a very faint red. The ears of this variety were similar to those illustrated in pl. 6, particularly those at the bottom and the top of the plate.



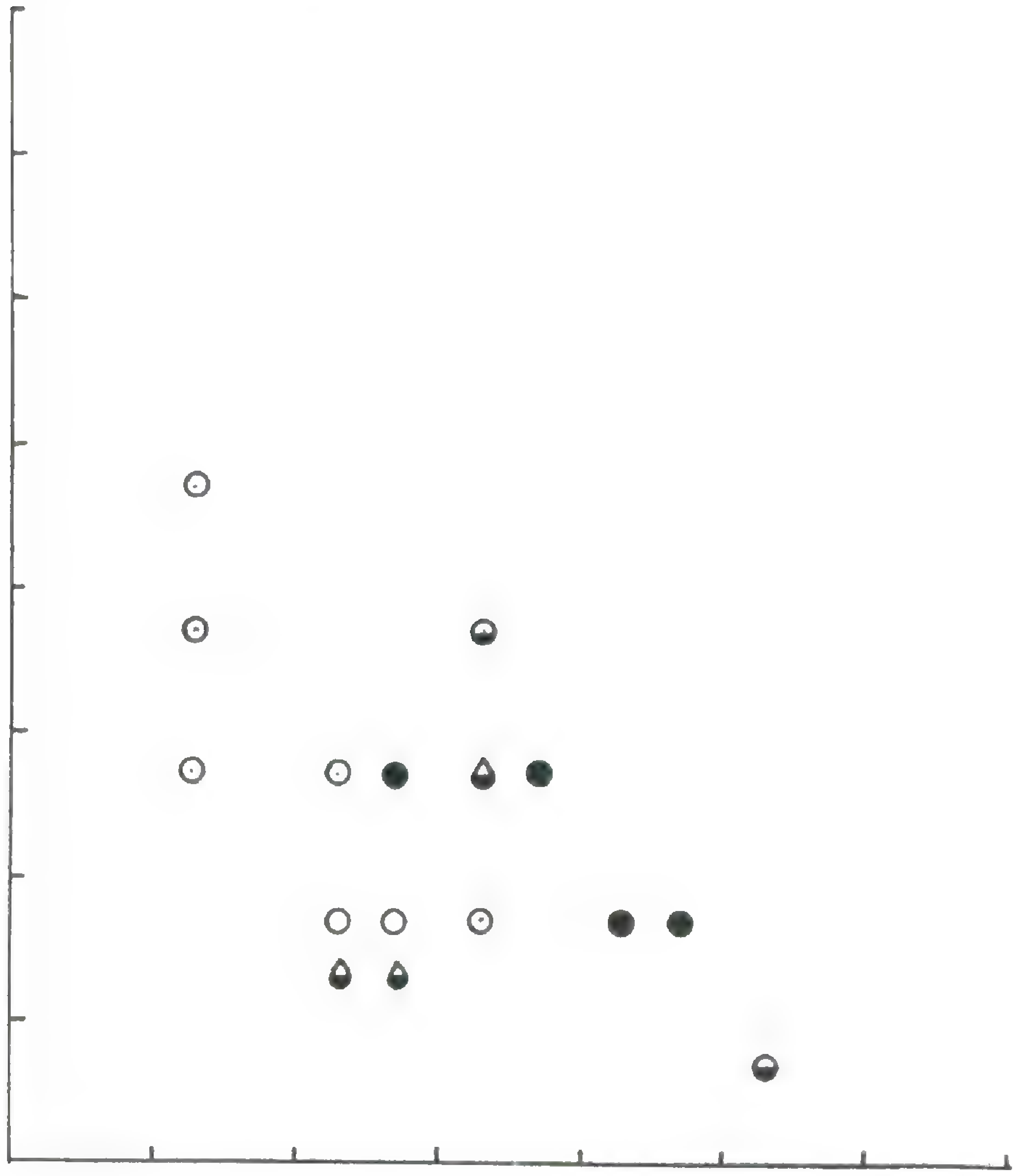
31. Coalcomán area, Michoacán. From clearing A.

This and the two following samples were sent me by Sr. F. Vargas Tentory, a member of a cultural mission to backward areas. These three collections were made in three different forest clearings in the Coalcomán area in western Michoacán. The 14- and 16-rowed specimens in each collection are very similar to *maiz reventador;* the remainder of the collections looks like crosses between that and typical Mexican Narrow Ear varieties.



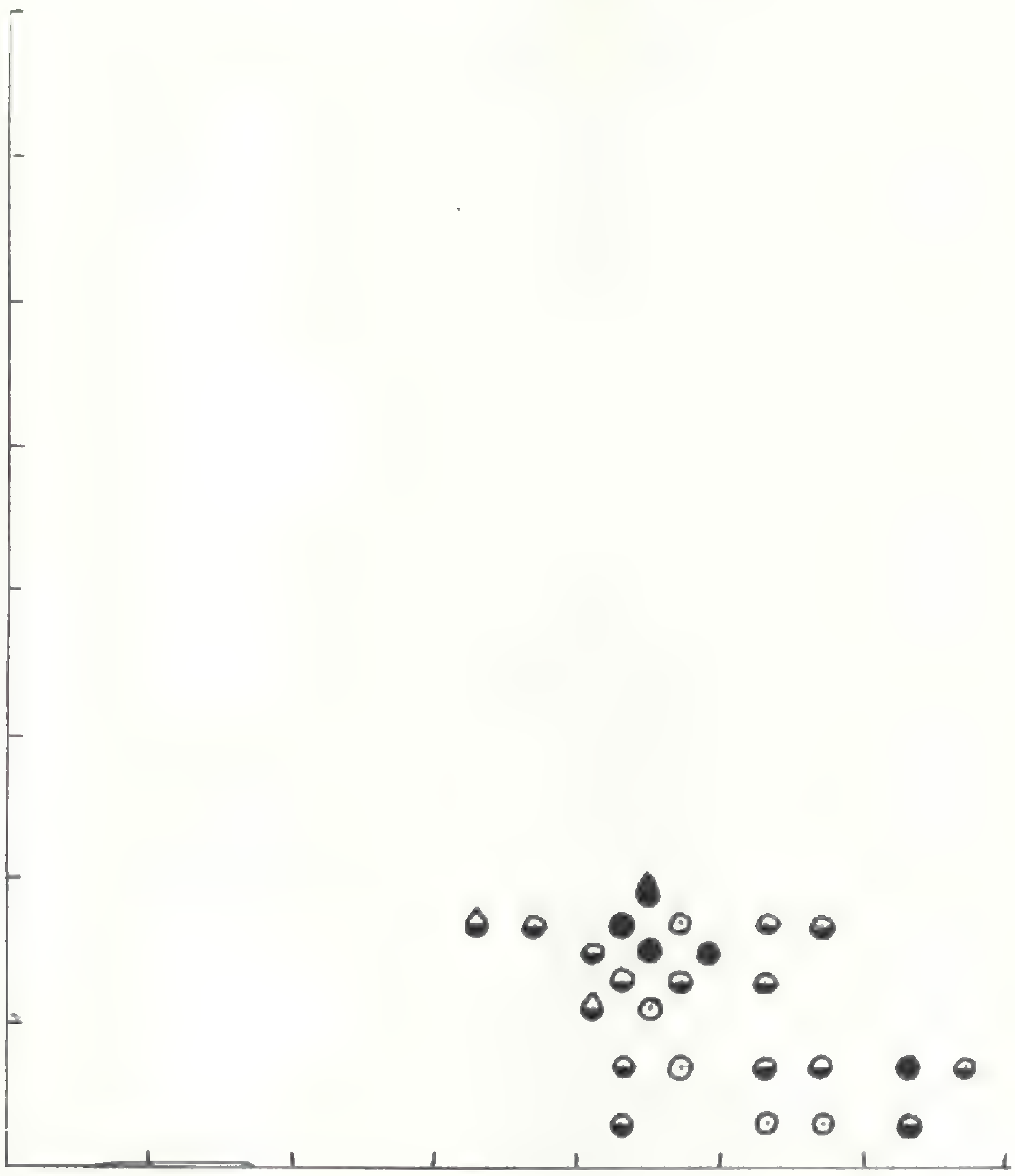
32. Coalcomán area, Michoacán. Clearing B.

See notes on the previous collection. These collections were variable as to color. A few had dark red pericarp (strong allele of *P*), a few had colored aleurone (*Pr*), and several showed a crowned pericarp (P^{cr}). The rest were white and yellow. One of the *Pr* ears had a single white kernel, indicating the presence of dominant white (C^{i}).



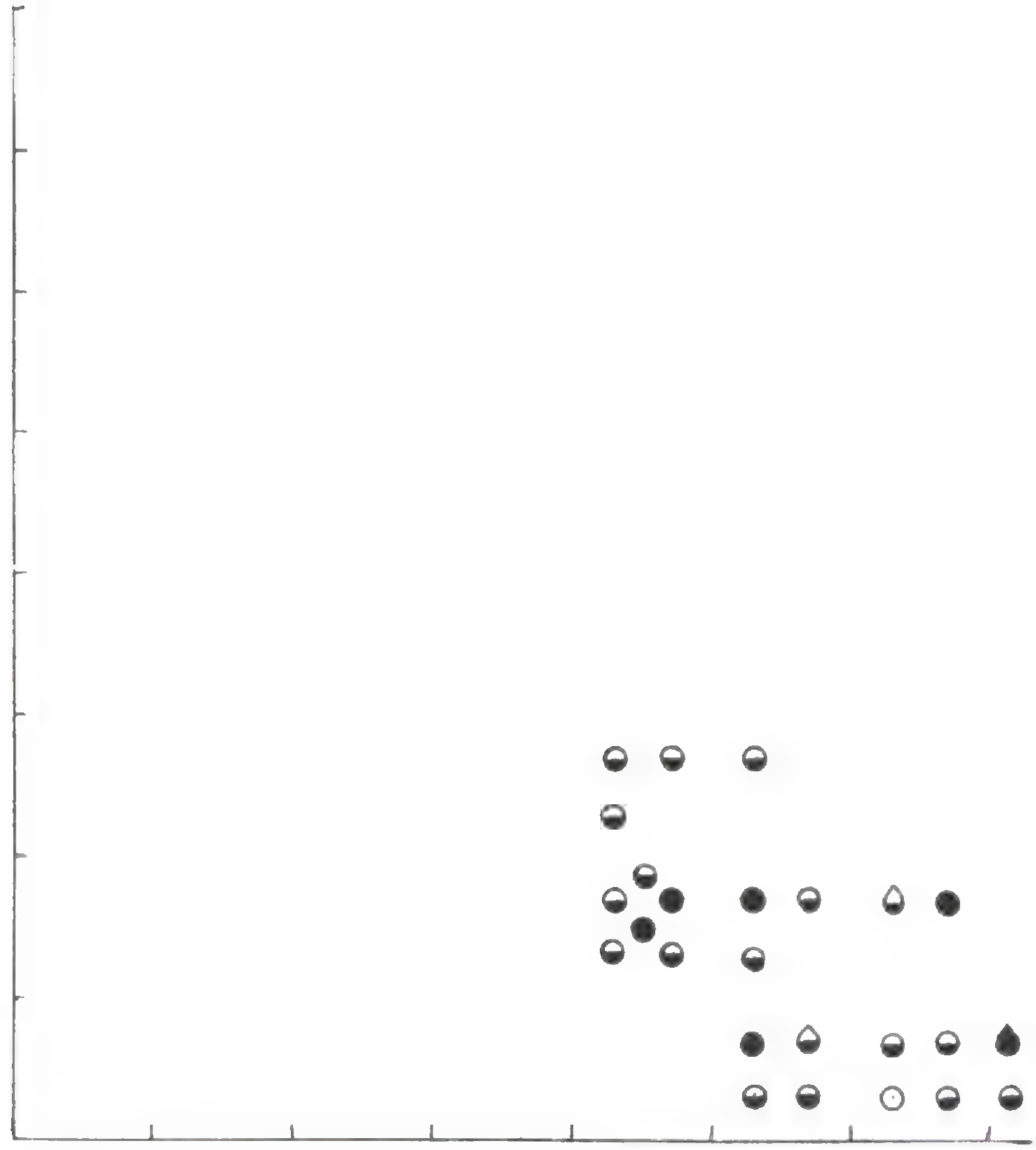
33. Coalcomán area, Michoacán. Clearing C.

See notes on two previous collections. These three collections do not represent samples from a single field, as do most of the examples in this Appendix, but are from all the varieties grown in each clearing.



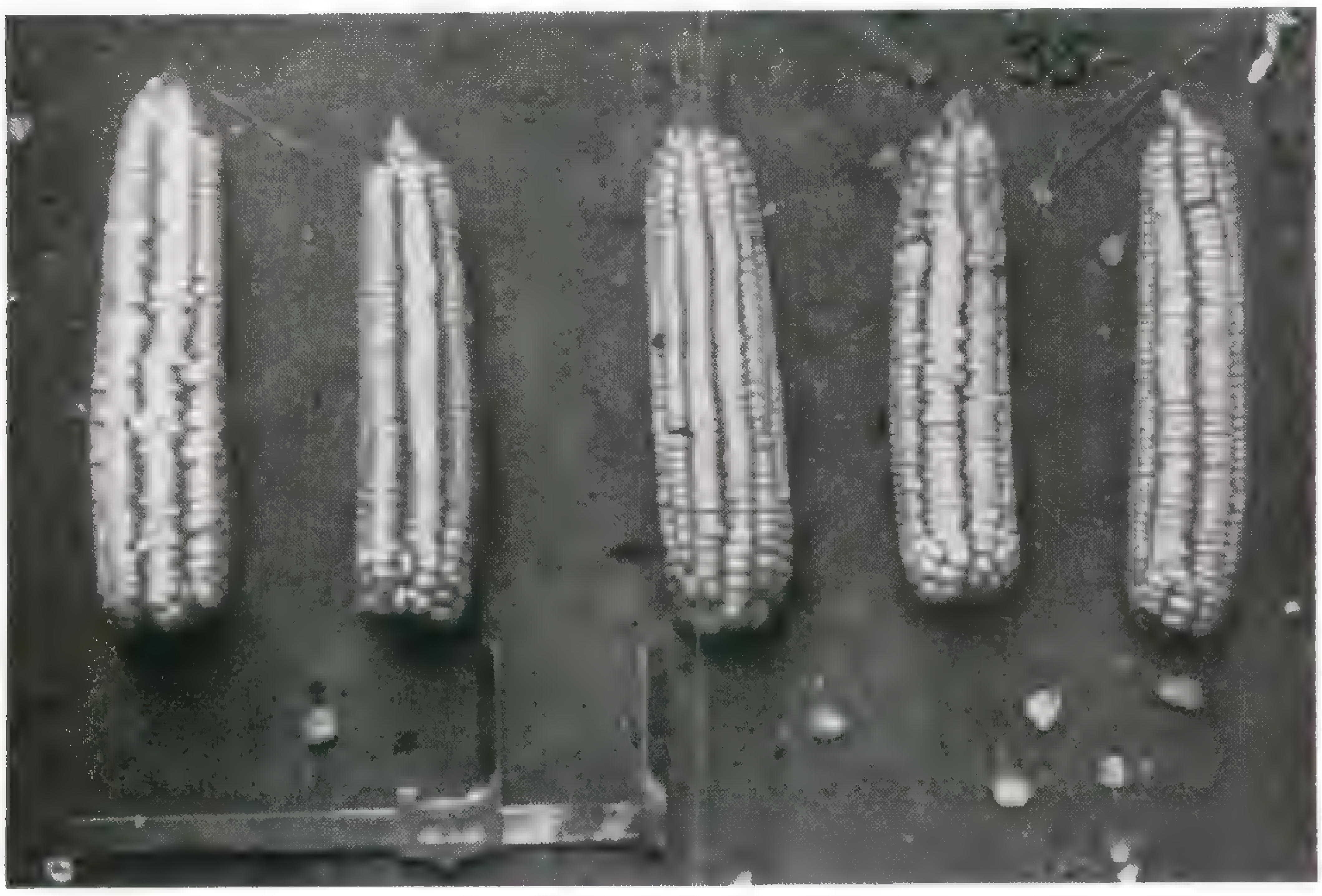
34. Apatzingán, Michoacán. *Maíz amarillo*

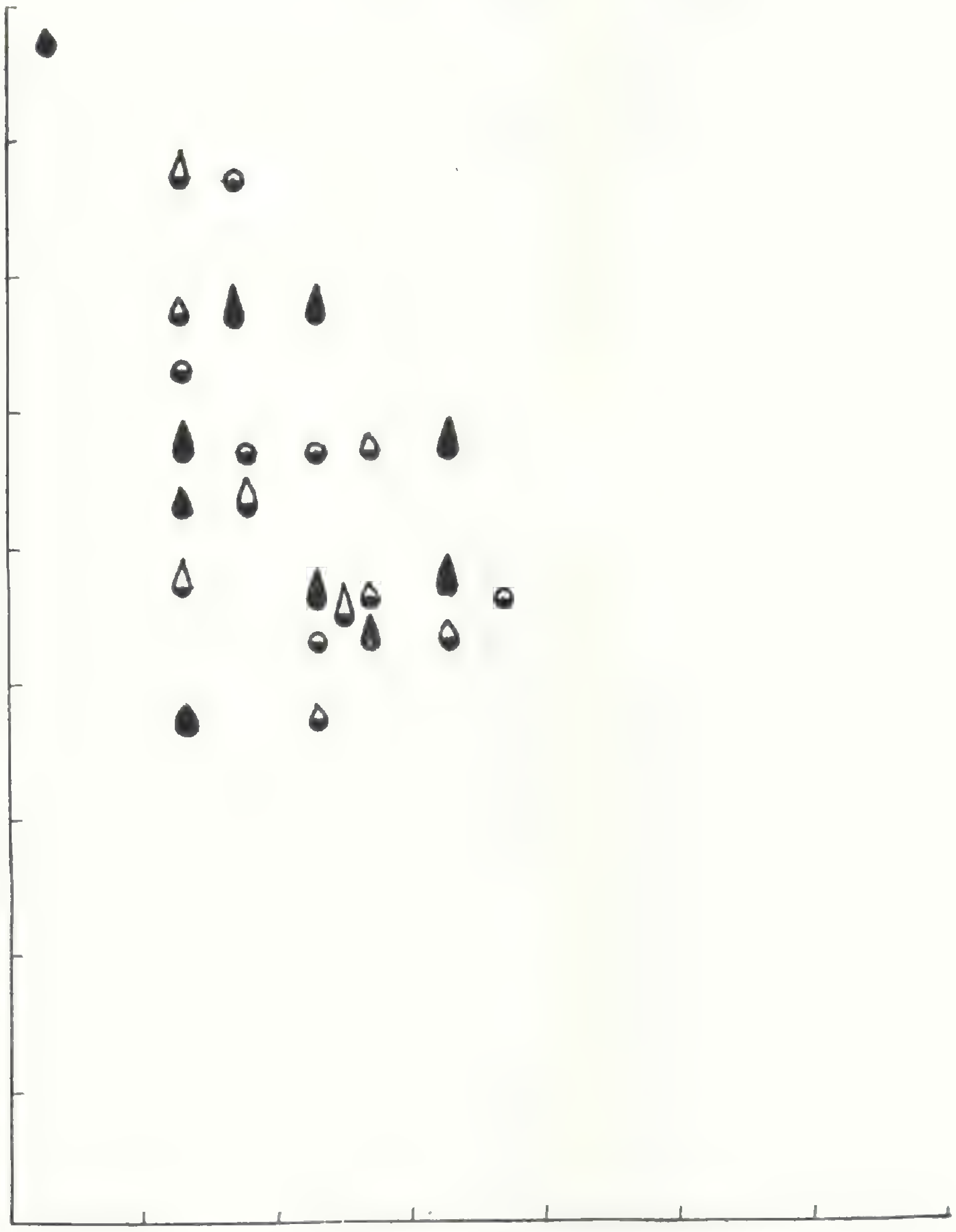
Prevailingly yellow. Two ears had white kernels. Eight of the ears had few to many kernels with colored aleurone *(Pr)*. One had tan pericarp.



35. Apatzingán, Michoacán. *Maíz amarillo*

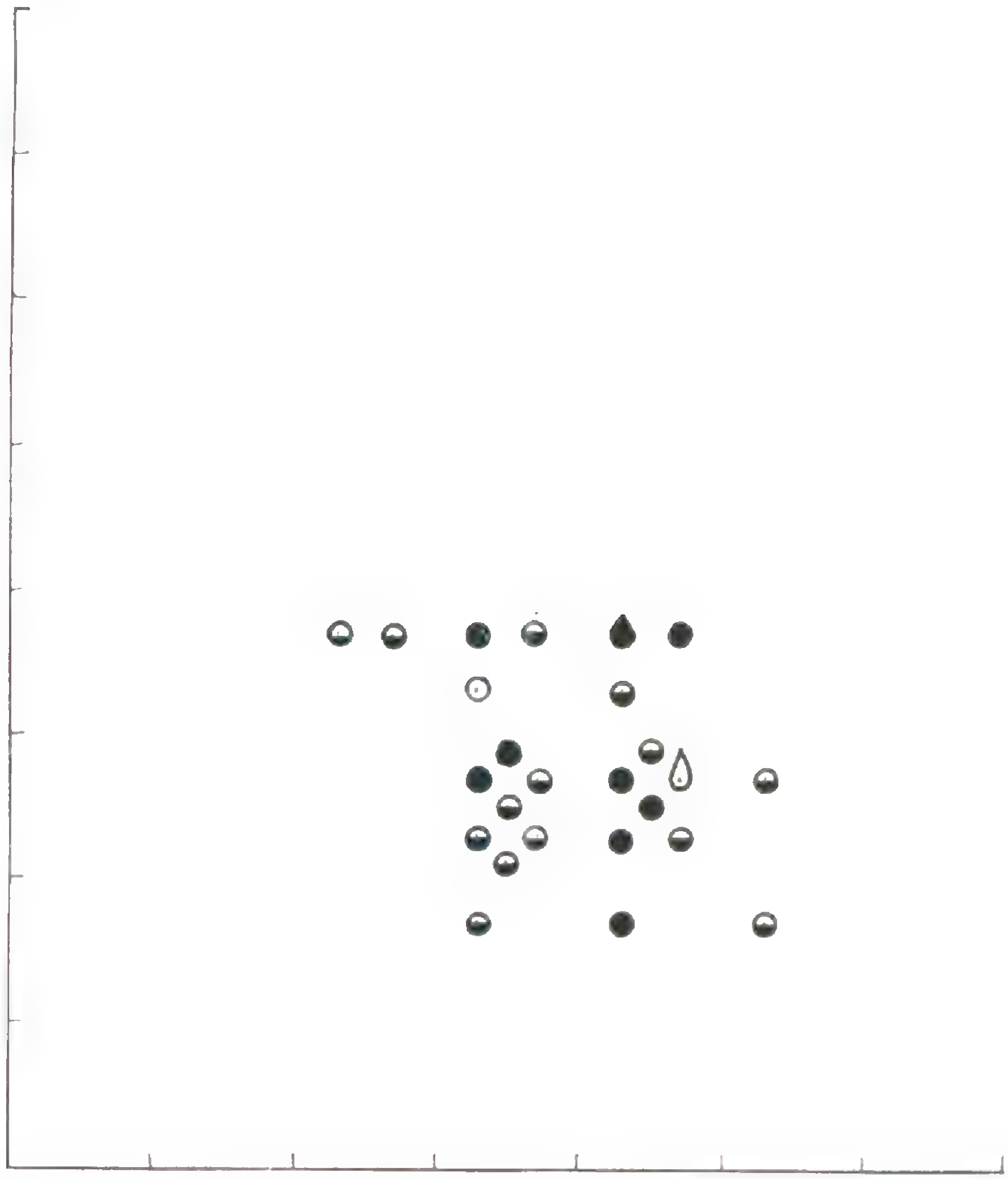
Prevailingly yellow. Eleven of the ears had white kernels; one had a tan pericarp.





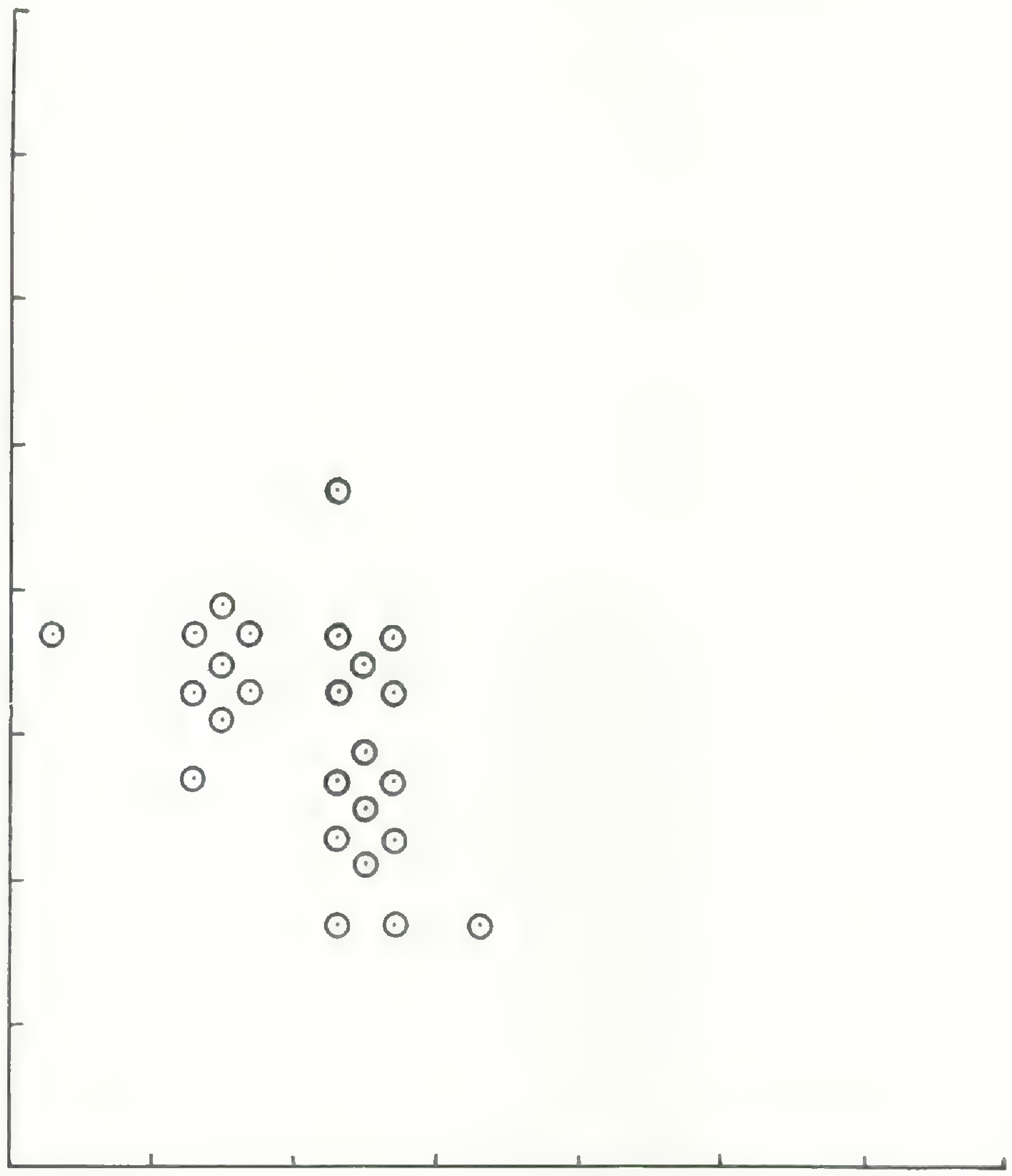
36. Jiquilpan, Michoacán. *Maíz pipitillo*

Prevailingly white, seven of the ears showing yellow kernels. Five ears had a few kernels with colored aleurone but they were all very faint in color. Apparently the white of this variety is almost dominant. The name *pipitillo* usually denotes a large-eared, many-rowed variety with long, more or less pointed kernels, dented and wrinkled below the point.



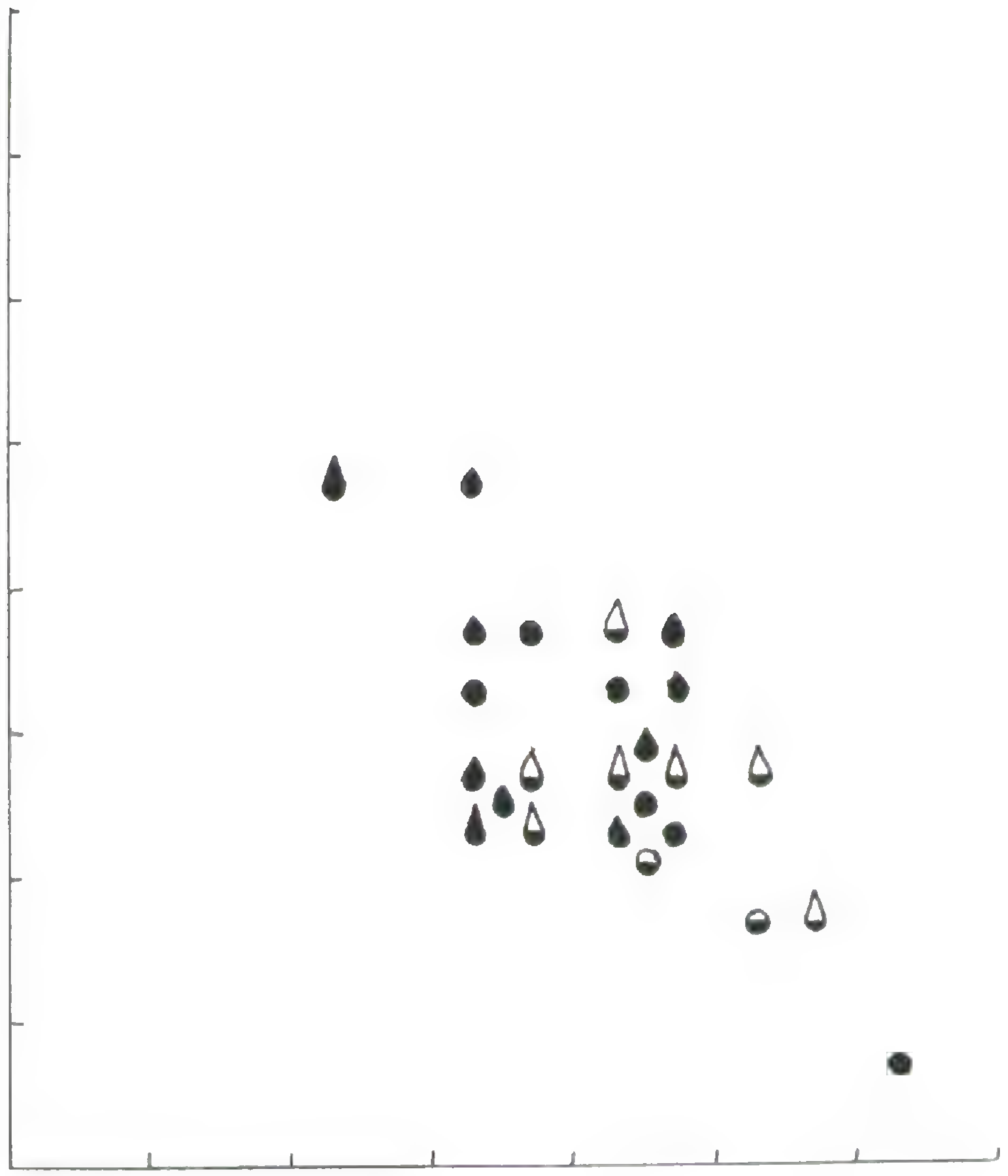
37. Jiquilpan, Michoacán. *Maíz amarillo*

Raised at La Cofradia in the hills above Jiquilpan. Prevailingly yellow. A few ears had white kernels, four had a few kernels with colored aleurone (*Pr*). Two ears had faint pericarp color (a low allele of *P*).



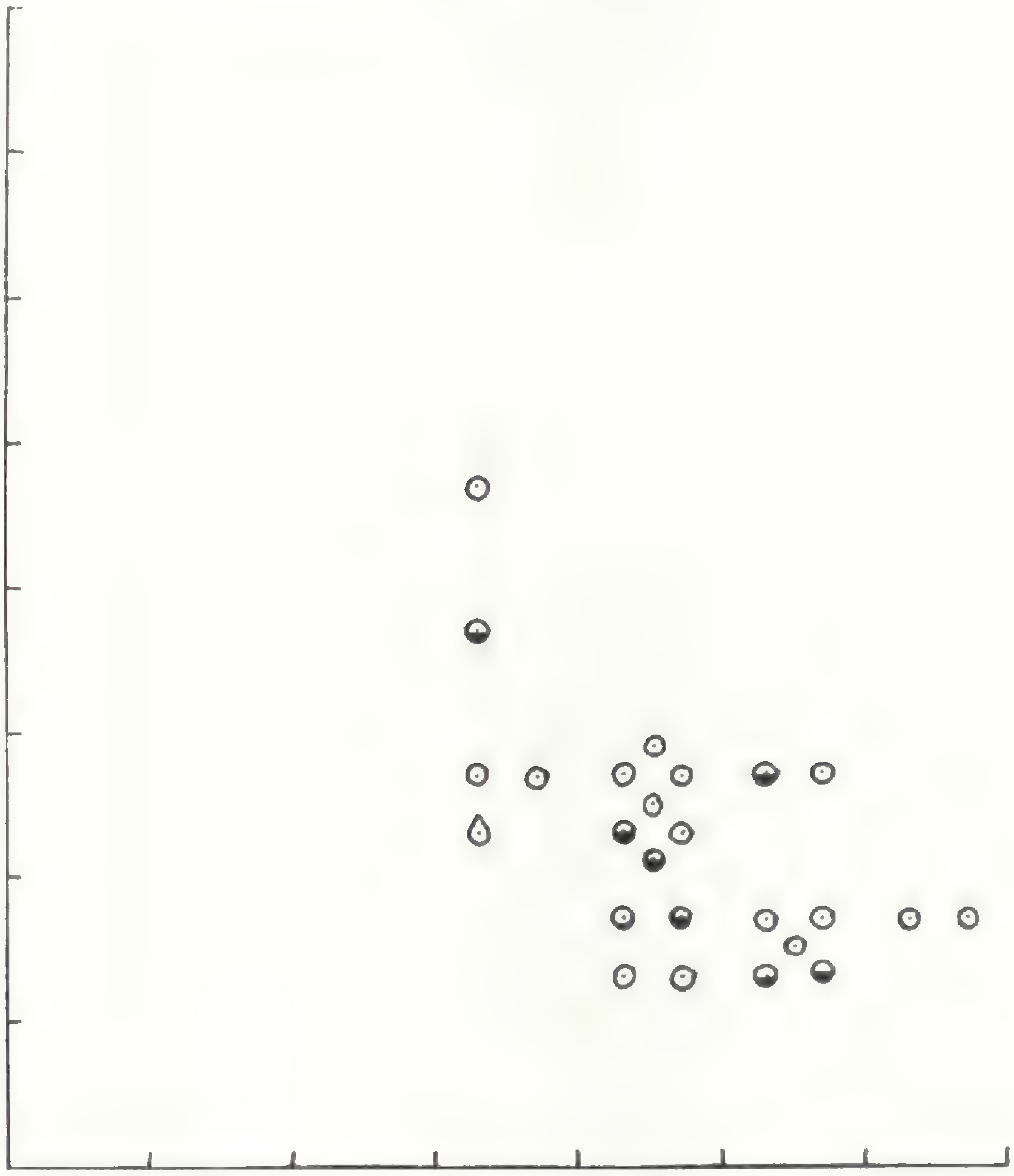
38. Jiquilpan, Michoacán. *Maíz rosquera*

This variety was identical with the *maiz reventador* of near-by Jalisco and not at all like the pointed popcorn sometimes called by the same name near Mexico City. All the ears bore both yellow and white kernels. Six had a few kernels with colored aleurone (both *Pr* and *pr*).



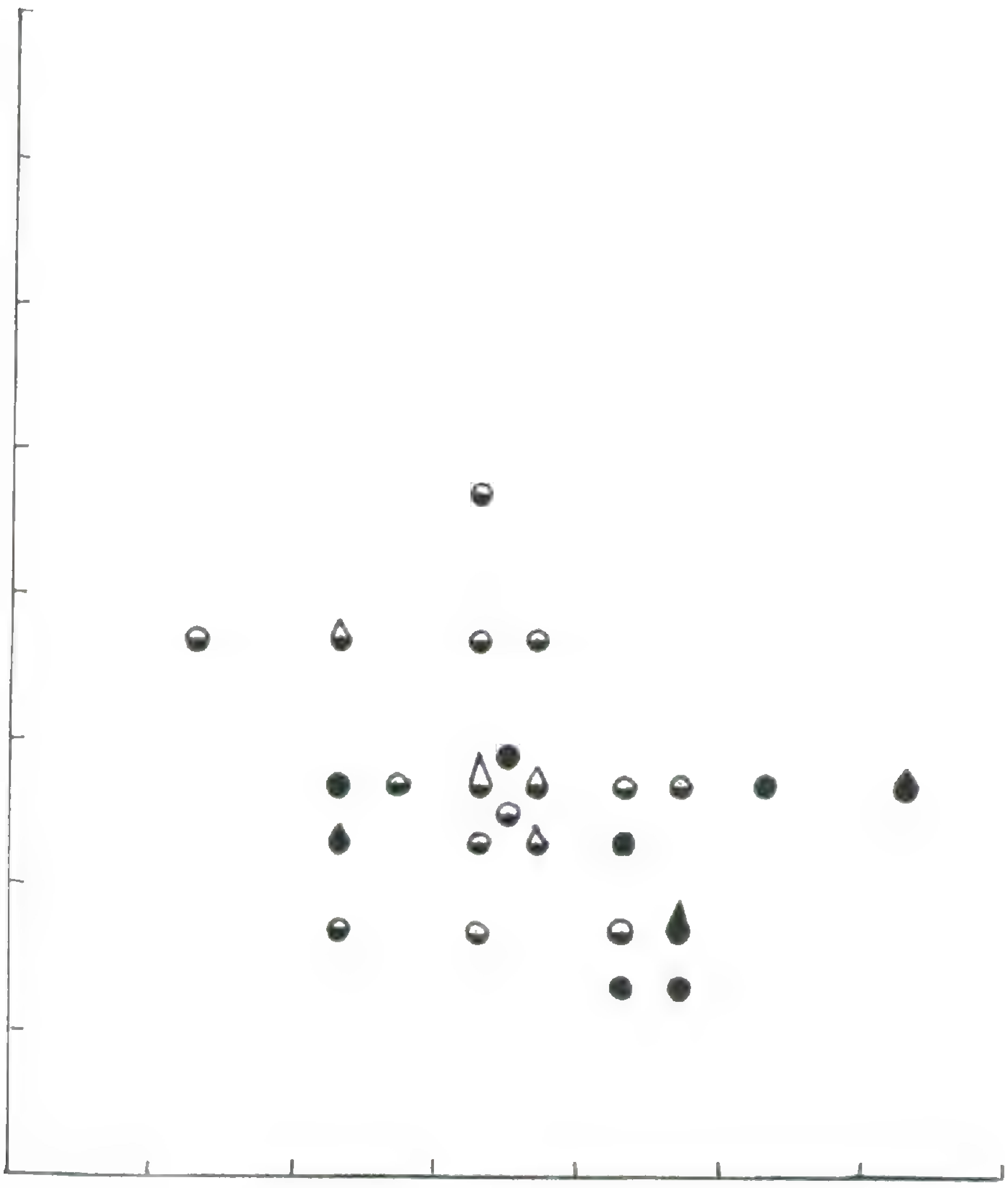
39. Jiquilpan, Michoacán. *Maíz grueso*

Prevailingly white. A majority of the ears had a few to many yellow kernels. Five had kernels with colored aleurone (*Pr*). One ear was flushed with brilliant color (allele of *R*).



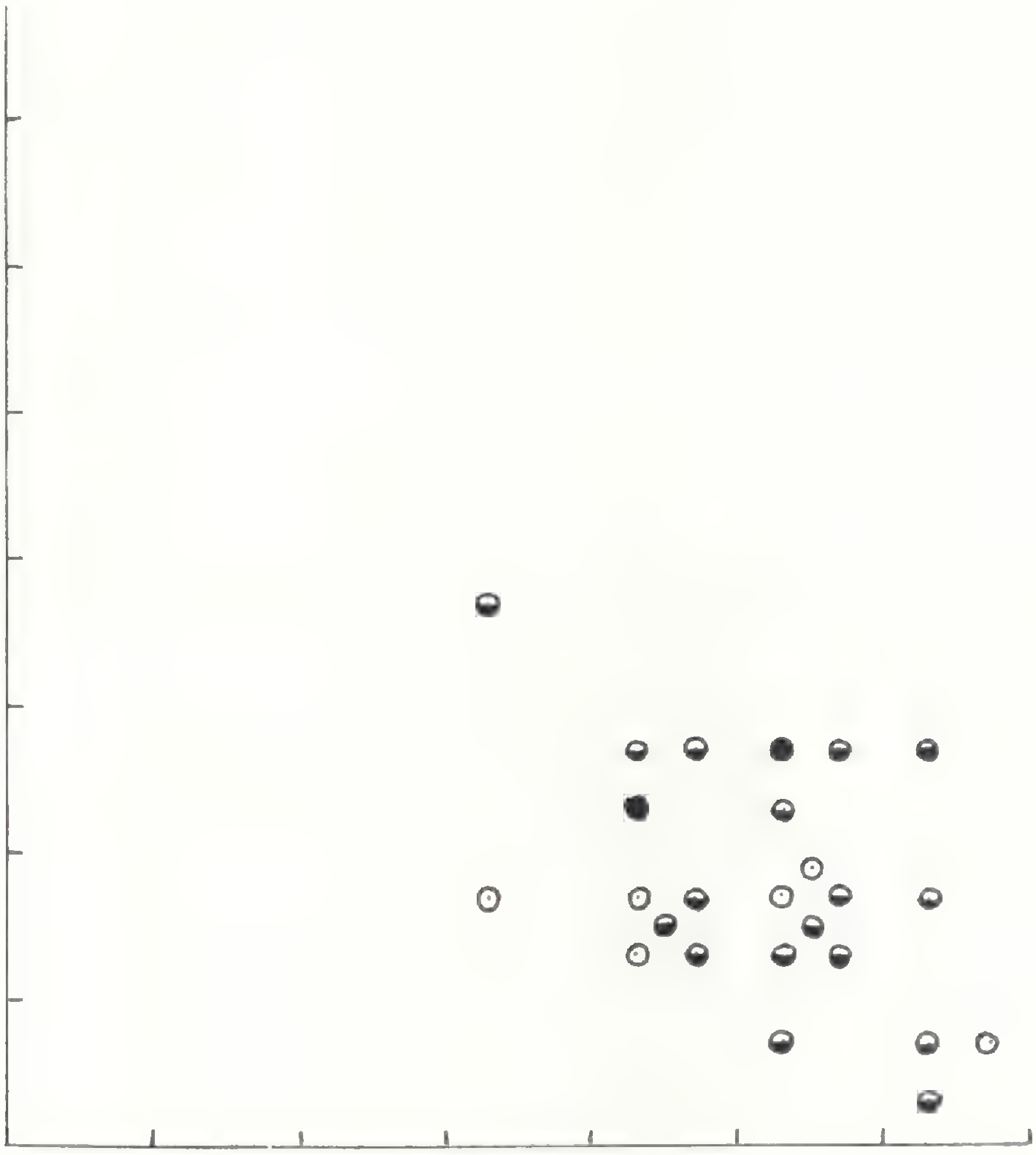
40. Jiquilpan, Michoacán. *Maíz negro*

Prevailingly dark blue (colored aleurone *Pr*). Several of the ears were segregating for *pr*. Nine of the ears showed white kernels but in such small numbers that it must have been due to pollination with dominant white *(C^I)* rather than segregation. Note how much wider-seeded and fewer-rowed this variety is, on the average, than the other samples from Jiquilpan. See discussion under "elote" varieties.



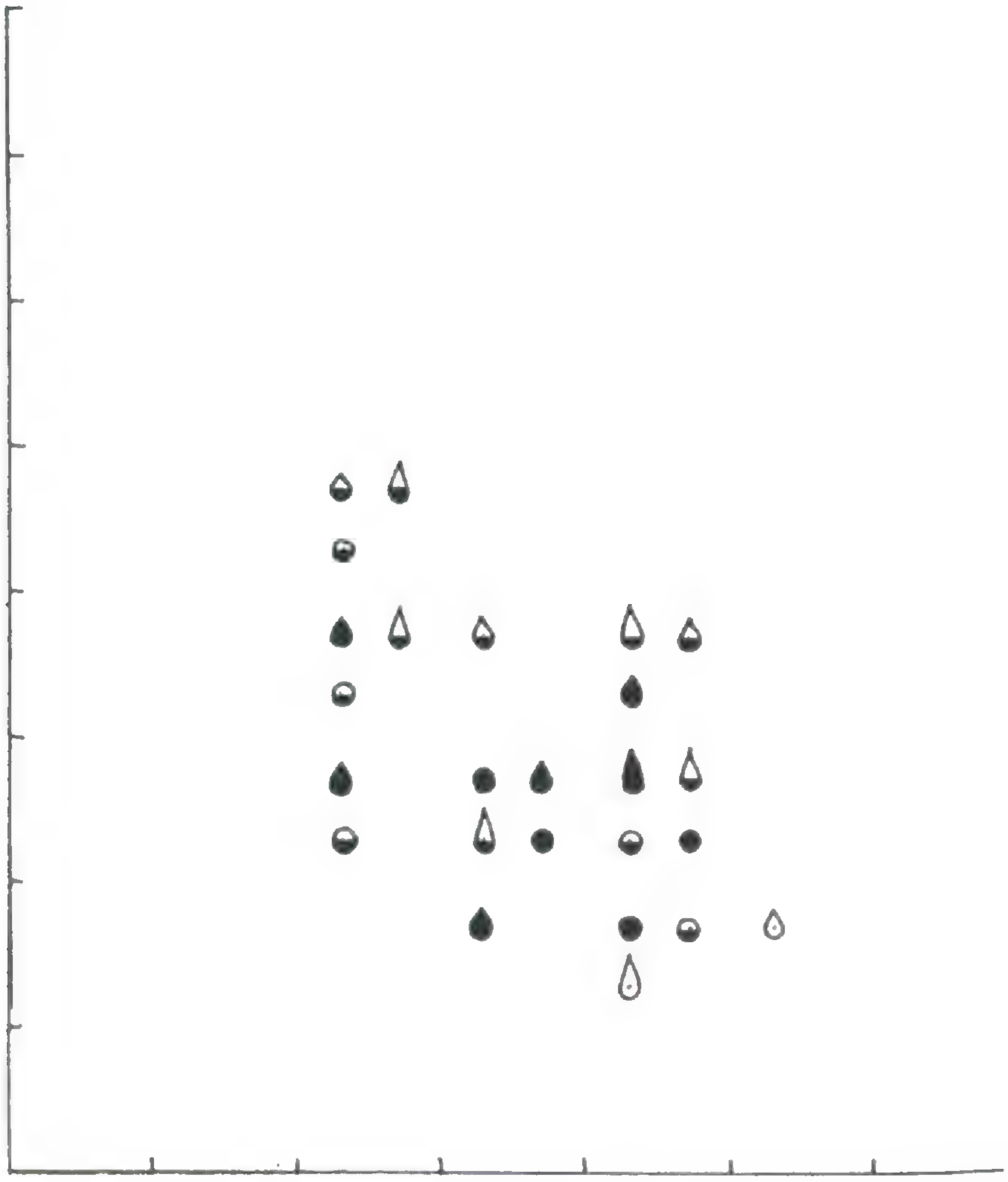
41. Uruapan, Michoacán. *Maíz criollo*

Prevailingly light yellow. Two ears with a few white kernels; two with a few kernels with colored aleurone (one *Pr* and one *pr*).



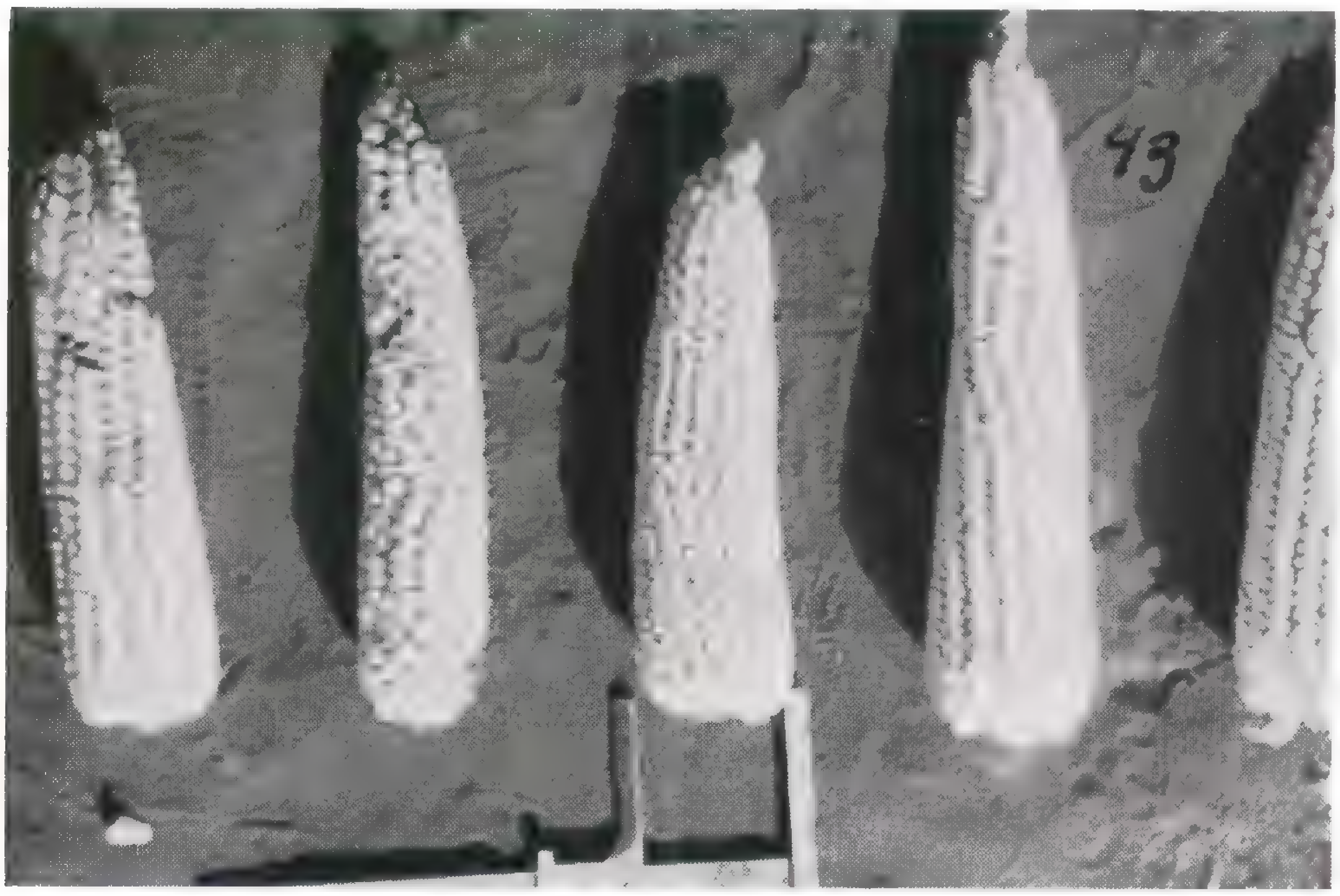
42. Uruapan, Michoacán. *Maíz breve.*

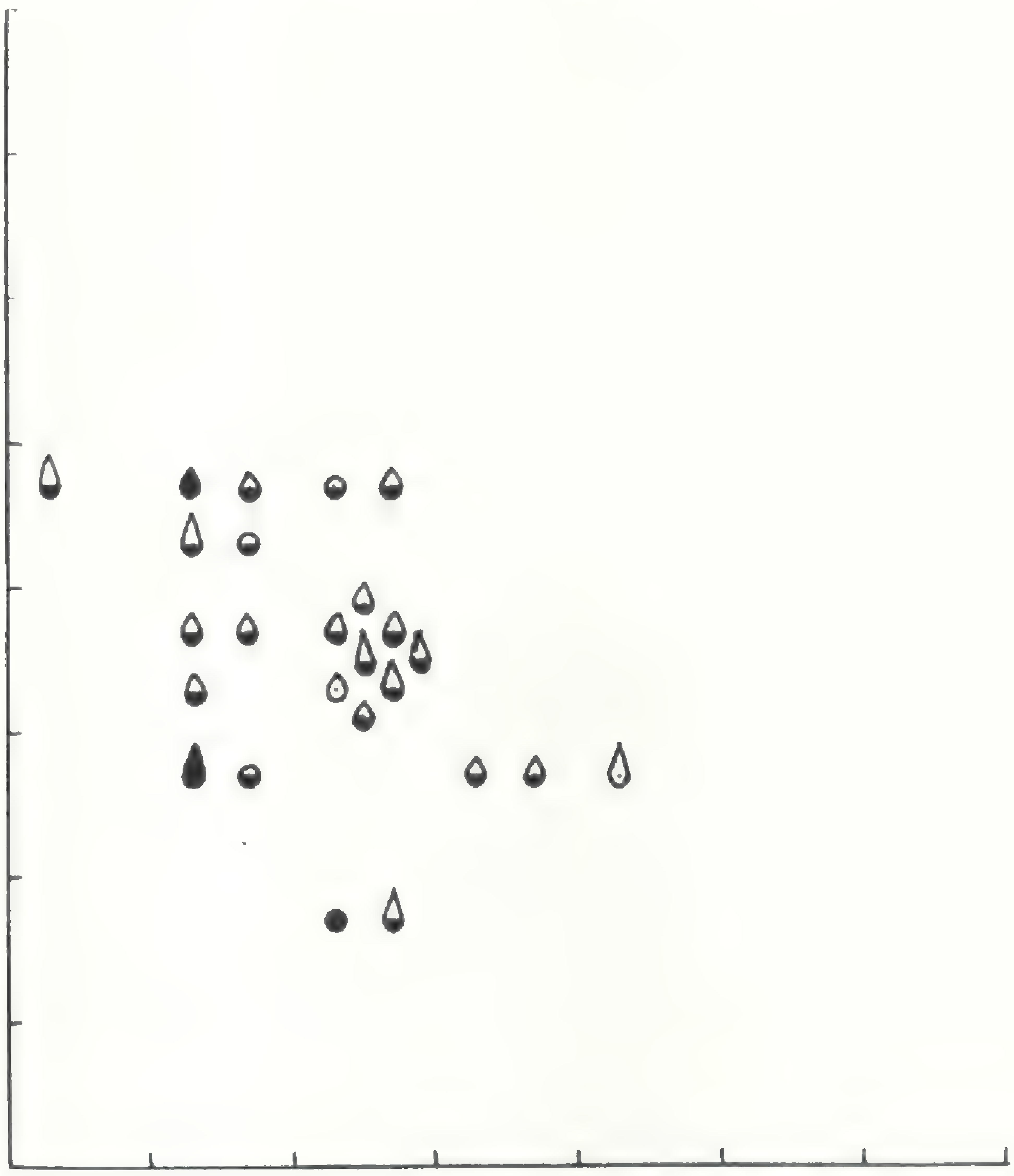
Prevailingly reddish aleurone *(pr)*, though a majority of the ears show few to many dark kernels *(Pr)* and one was segregating. Seven had colored pericarp *(P* and P^{cr}*)*.



43. San Lorenzo, Michoacán. *Maíz del cerro*

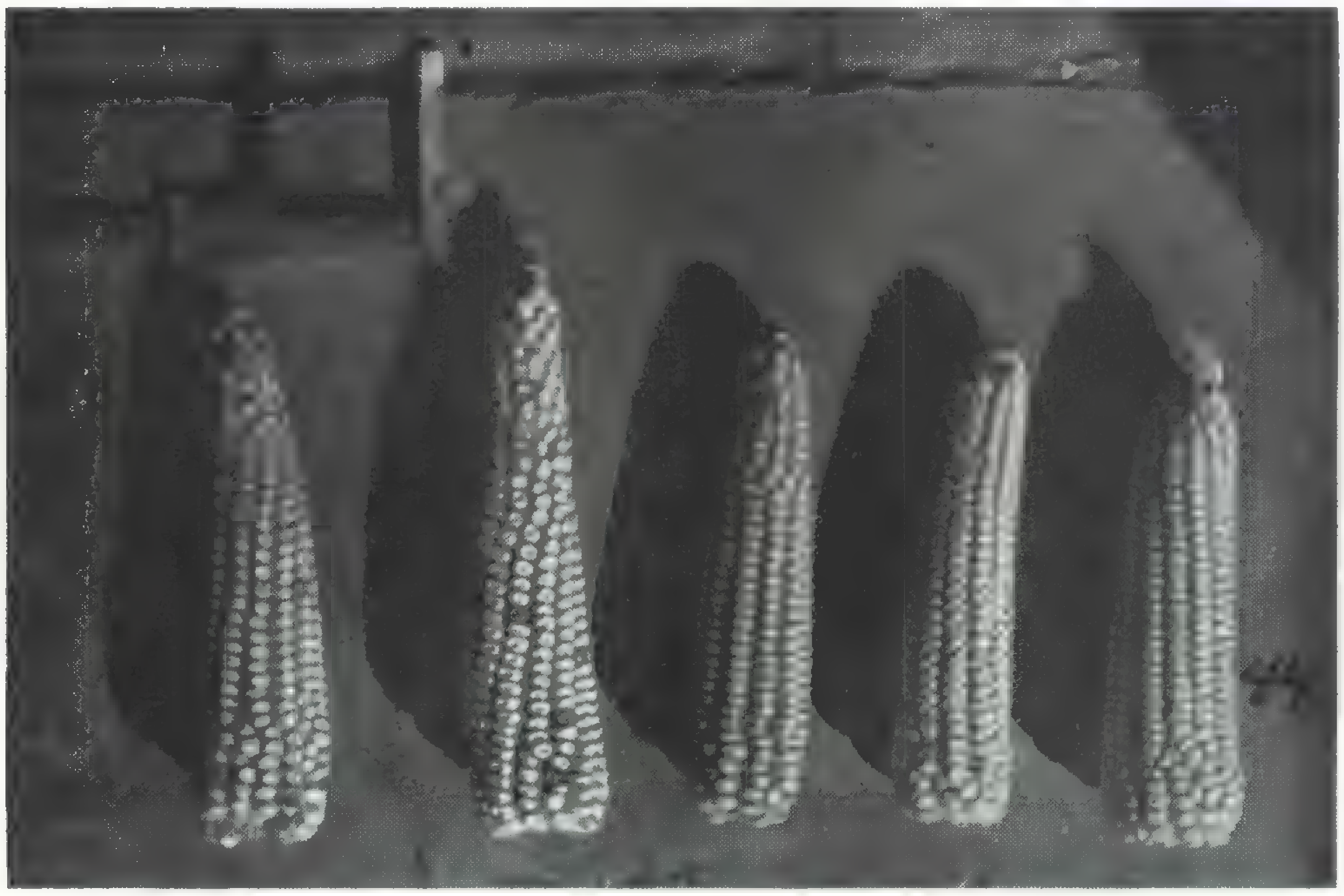
Prevailingly white and yellow. A few ears with dark aleurone *(Pr)* on a few kernels. Two ears flushed pink (allele of *R*?) Crop stunted by new volcanic ash.

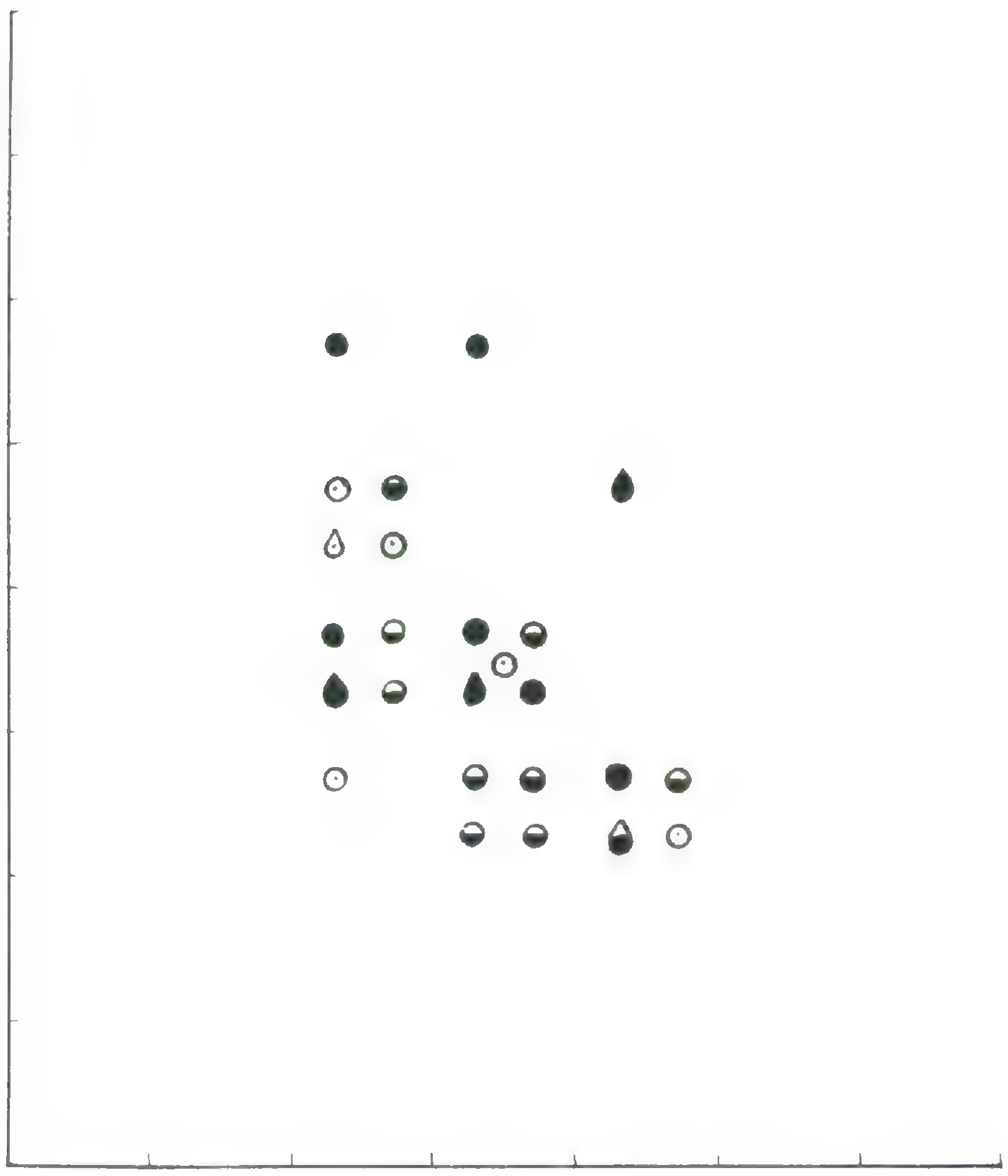




44. Cherán, Michoacán. *Maíz tulekenio*

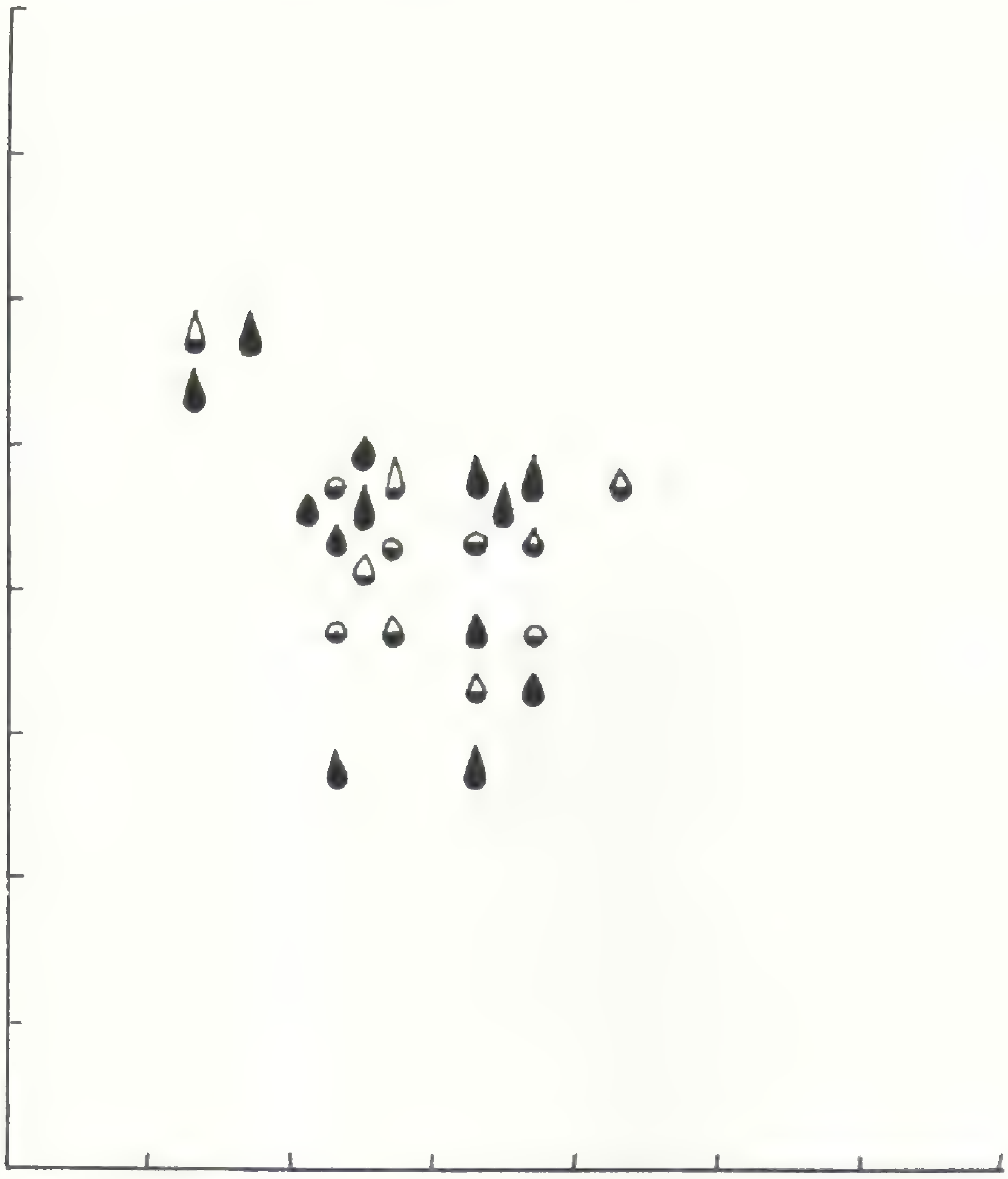
White and yellow in various mixtures. Seven of the ears had bright pink or red in the pericarp (various alleles of *R*?). Six ears had a few kernels with dark aleurone *(Pr)*.





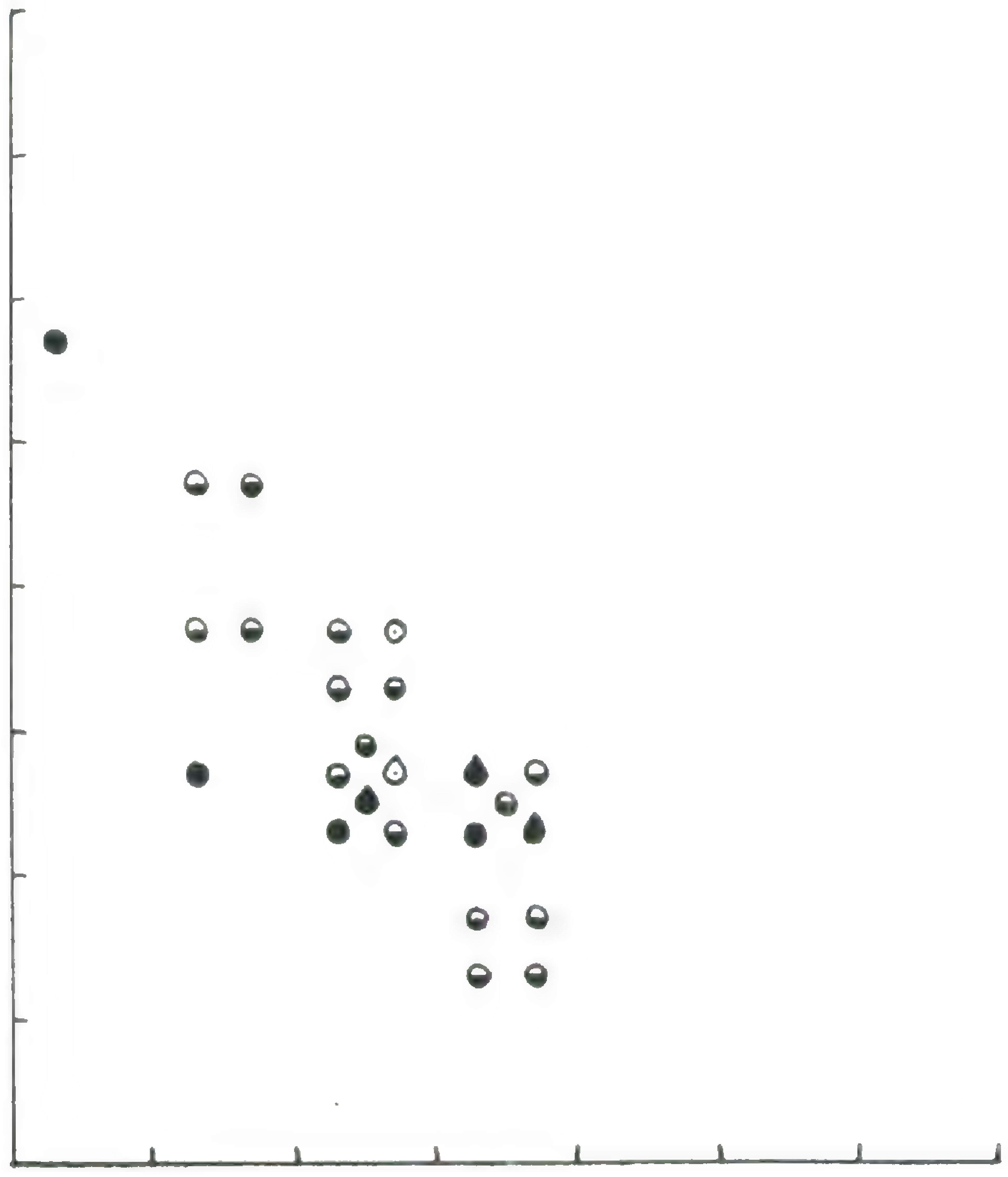
45. Cherán, Michoacán. *Maíz pinto*

This is the black corn discussed in detail in the Appendix to Beal's report on Cherán. Prevailingly dark aleurone *(Pr)*, many with light to dark red purple in the pericarp (alleles of *R*?).



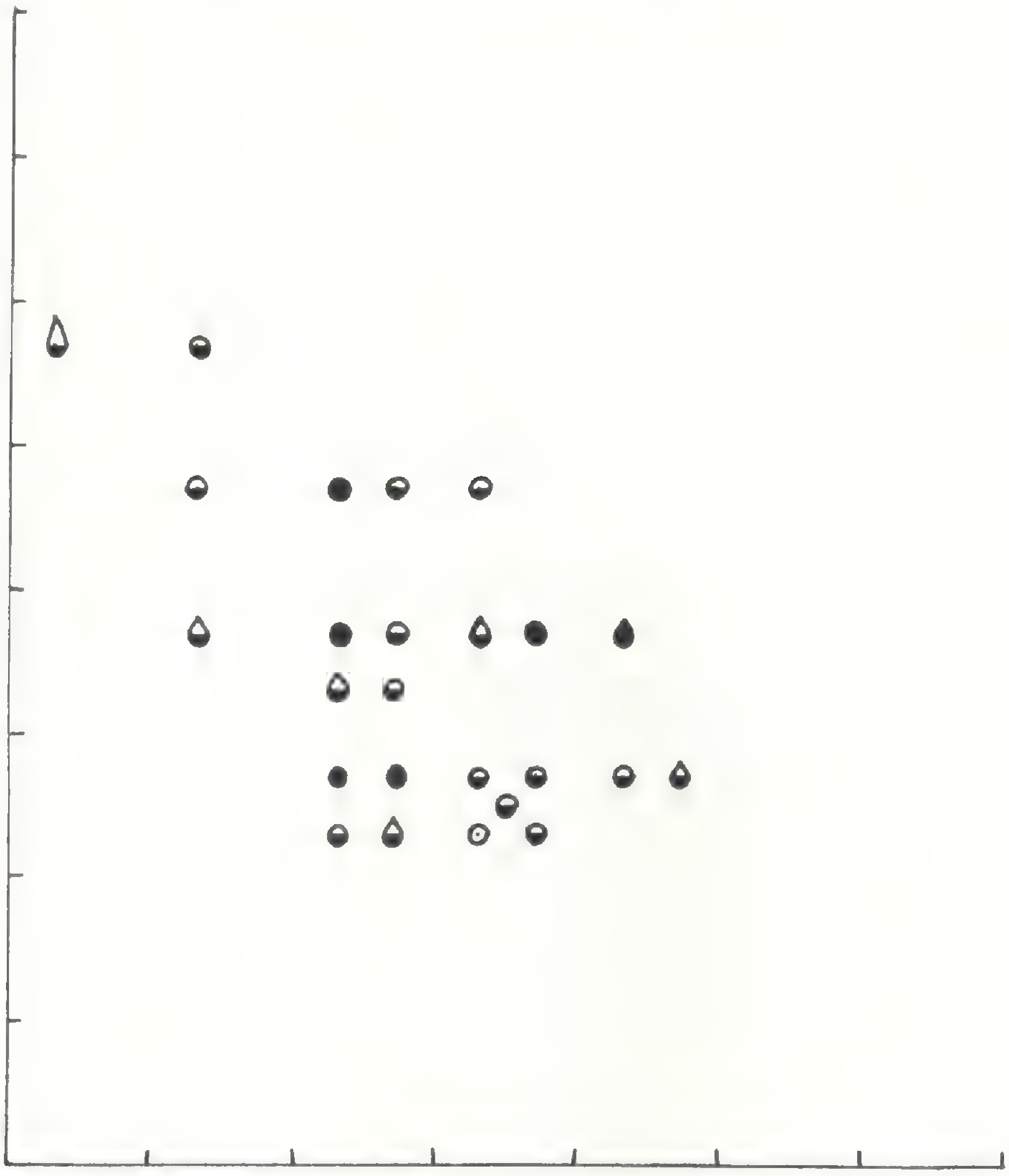
46. Cherán, Michoacán. *Maíz blanco del cerro*

Prevailingly white with a few yellow kernels. Two ears had a few kernels with dark aleurone *(Pr)*. Two showed color in the pericarp.



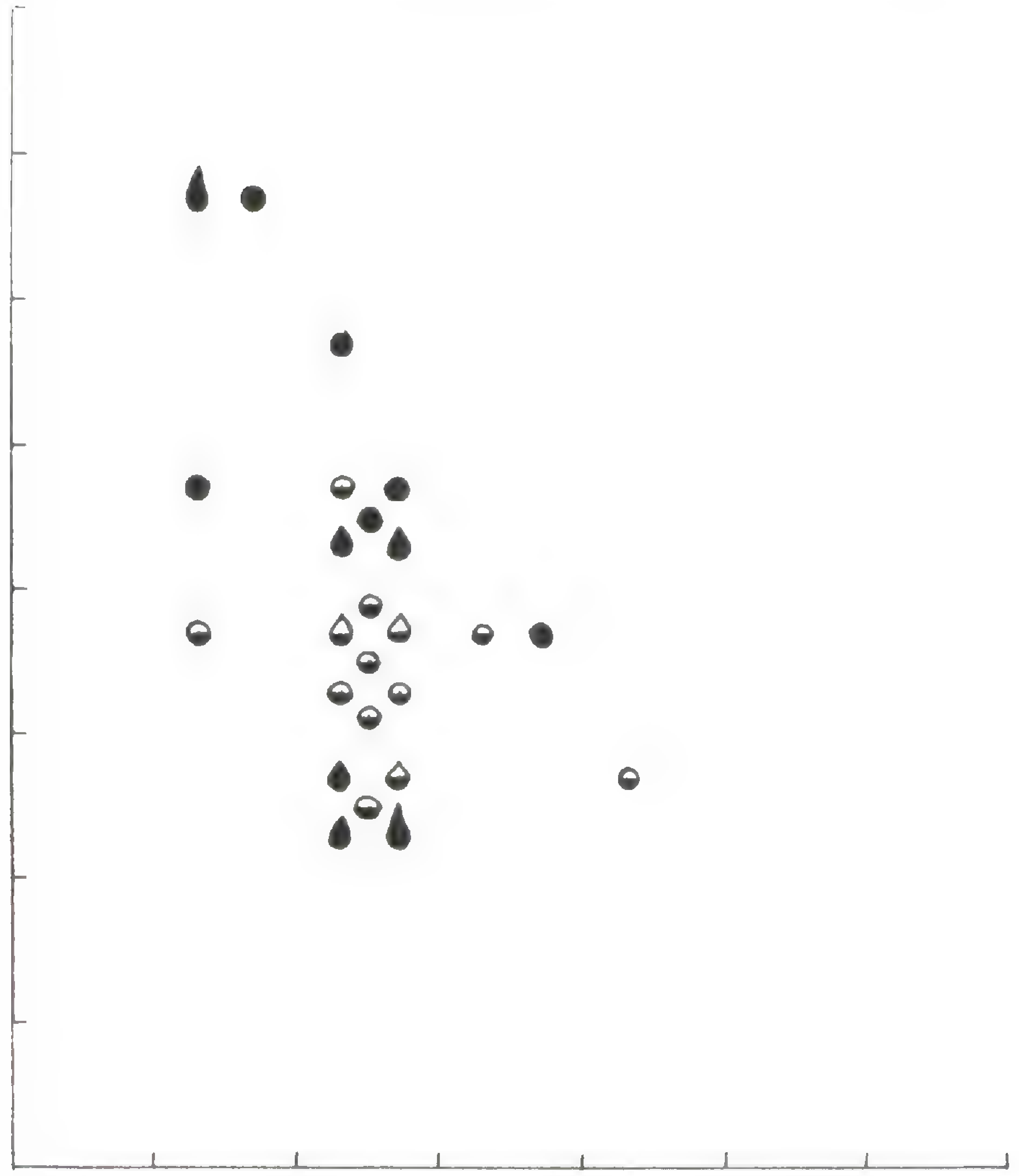
47. Pátzcuaro, Michoacán. *Maíz pinto*

Grown on a small farm, "Las Paredis." Prevailingly white. Nearly all the ears with some kernels showing colored aleurone (usually *Pr*, sometimes *pr*).



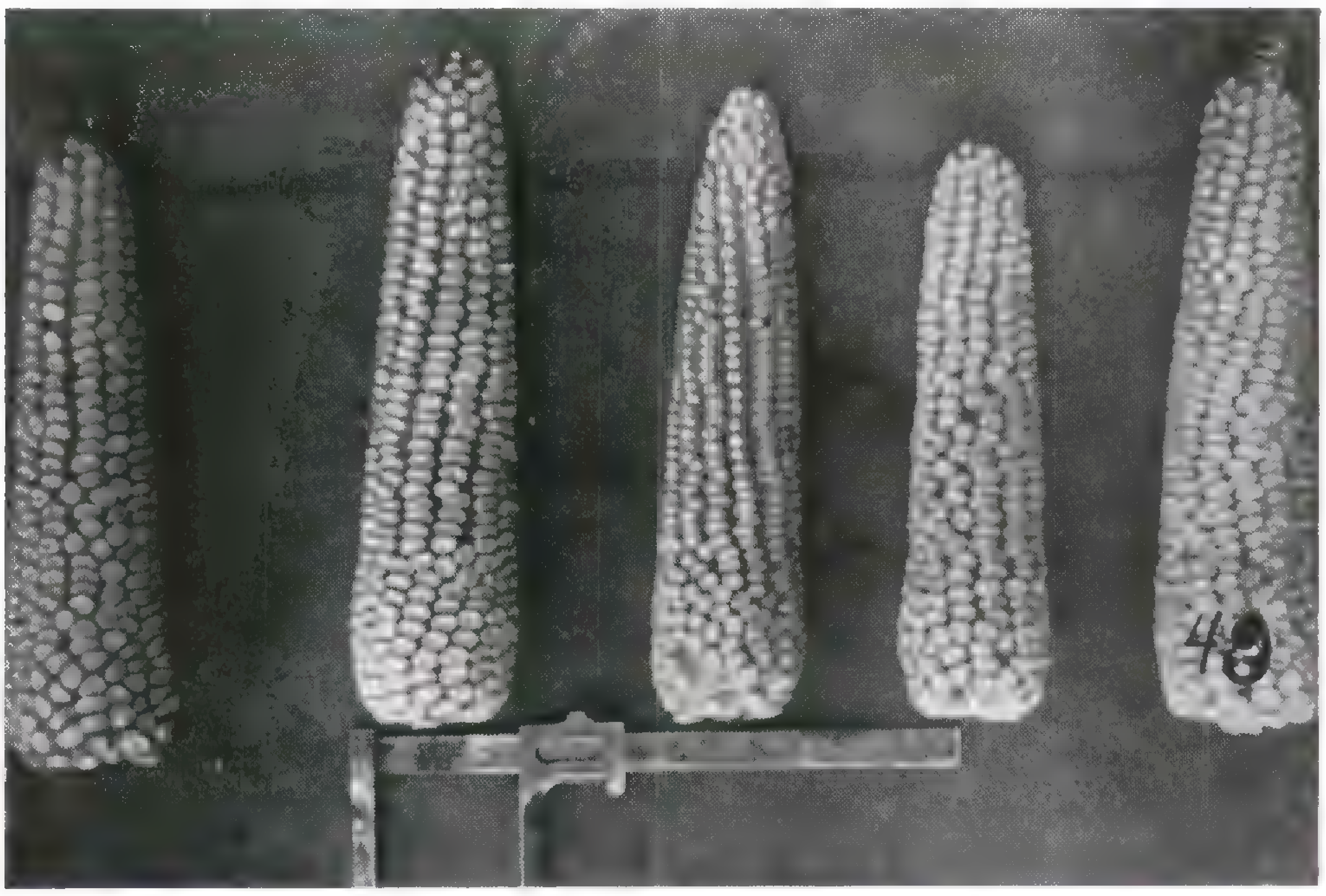
48. Pátzcuaro, Michoacán. *Maíz blanco*

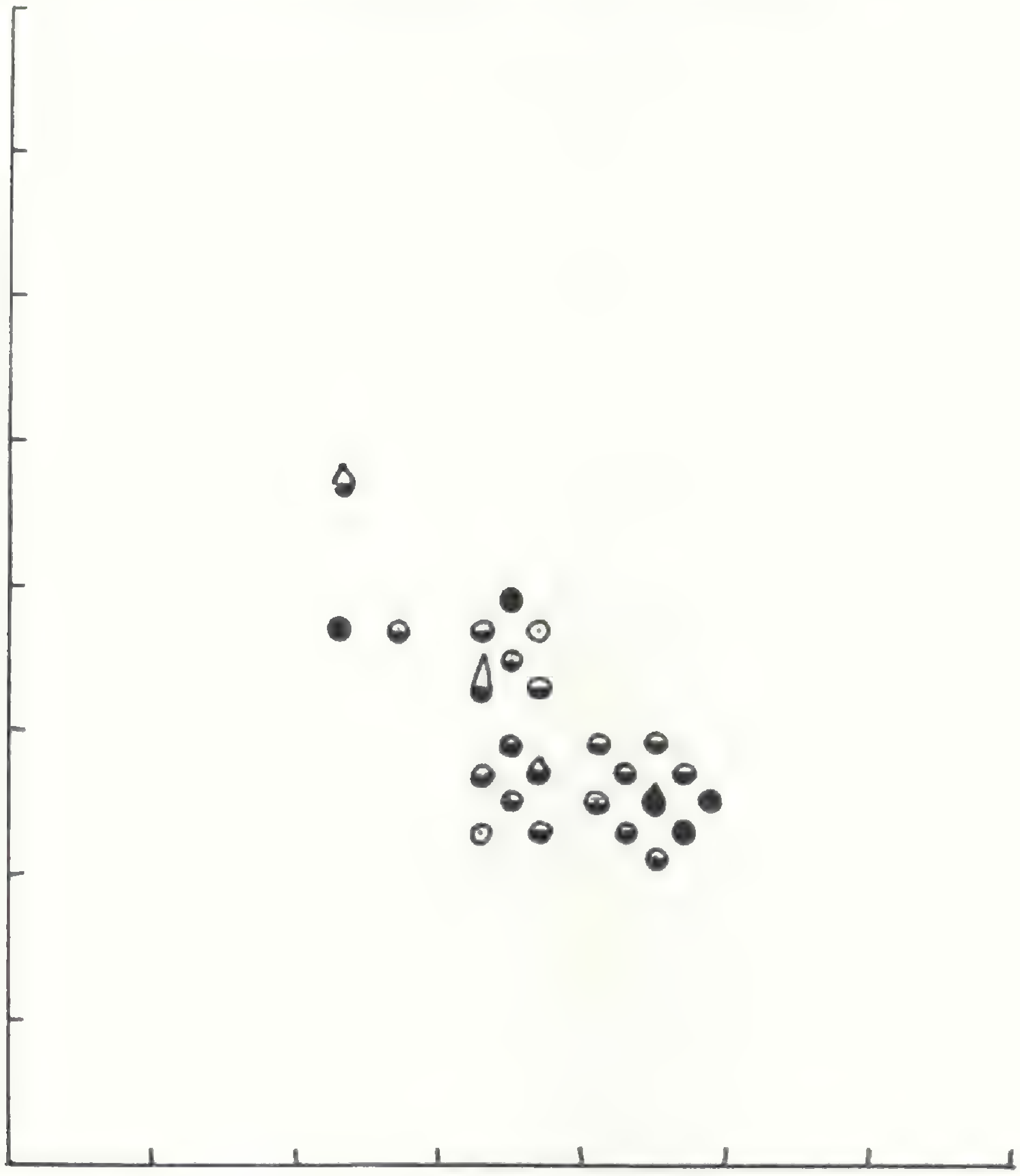
From a field one mile above the town. Prevailingly white and very pale yellow. Three ears with a few kernels with dark aleurone *(Pr)*; two ears with colored pericarp.



49. Lake Pátzcuaro, Michoacán. *Maíz blanco*

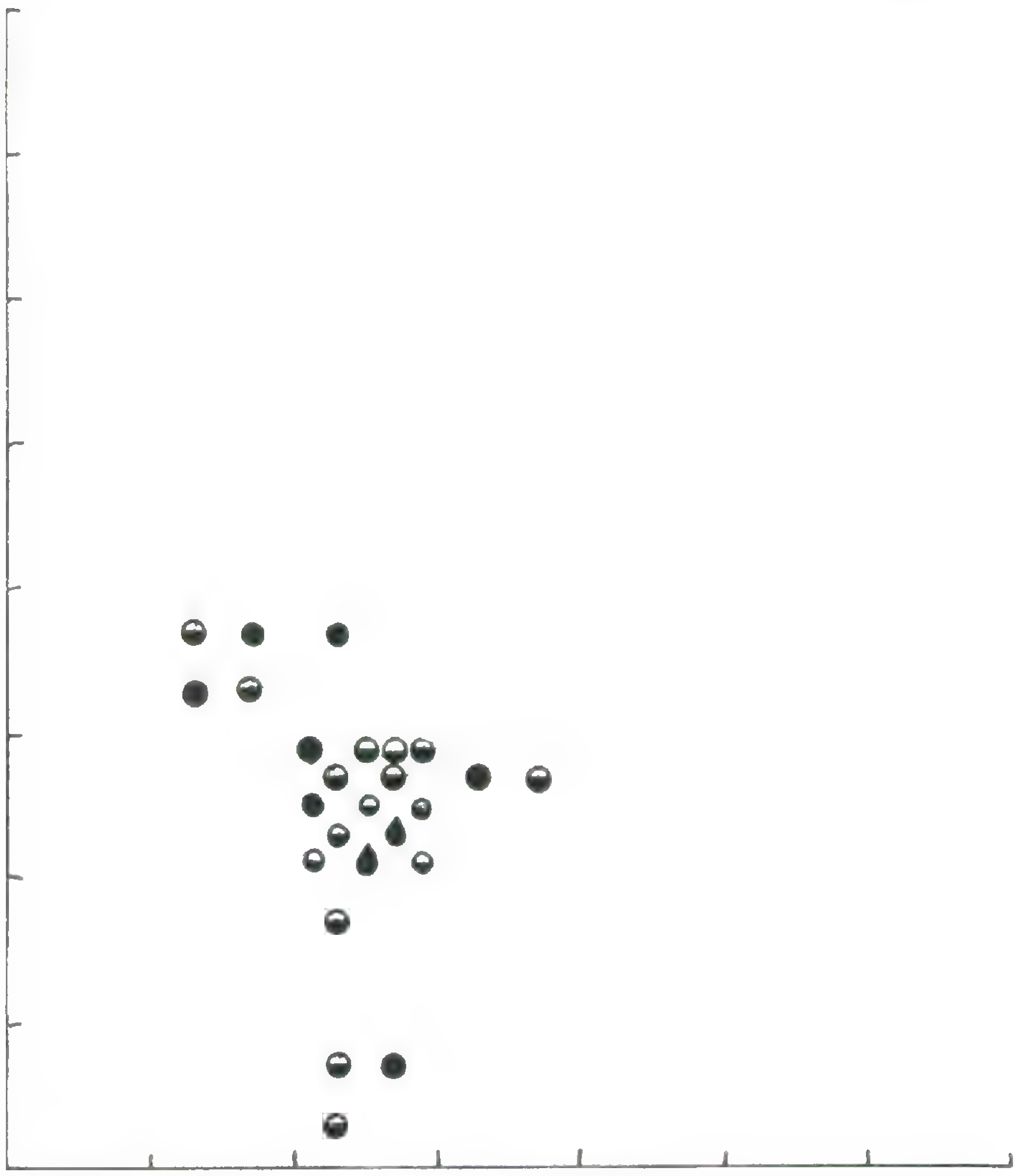
Prevailingly white. Most of the ears with some yellow kernels. Four ears with crowned pericarp *(P^{cr})*. Several ears with colored aleurone *(Pr* and *pr)*.





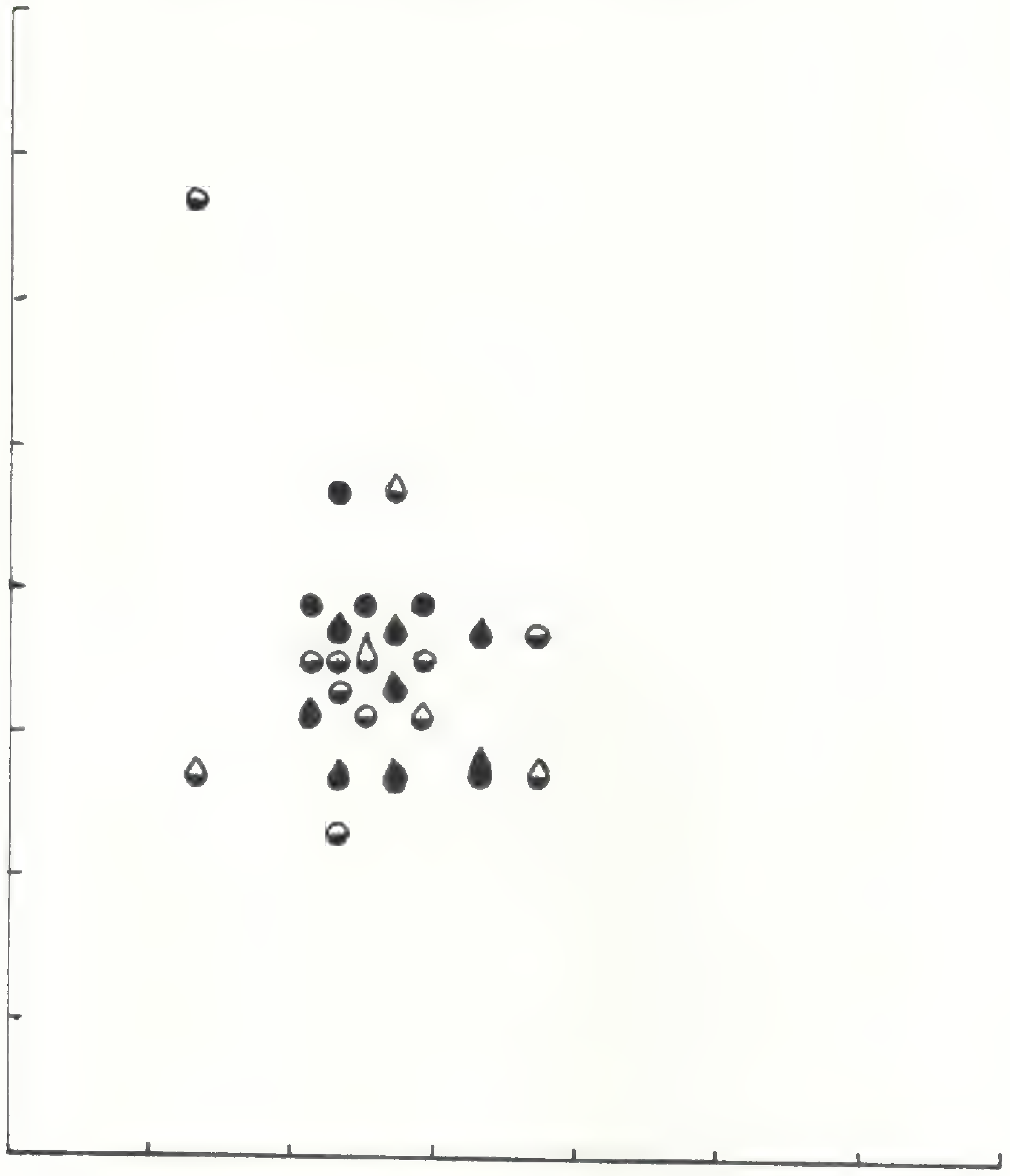
50. Lake Pátzcuaro, Michoacán. *Maíz colorado*

Prevailingly dark aleurone *(Pr)*, though many of the ears are segregating for reddish aleurone *(pr)* and a few are mainly *pr*. Over half the ears with a few to many white kernels, some of them due to pollination with dominant white (C^i); one ear, for example, had *Pr* and *pr* kernels and a single kernel of pure white with no trace of color.



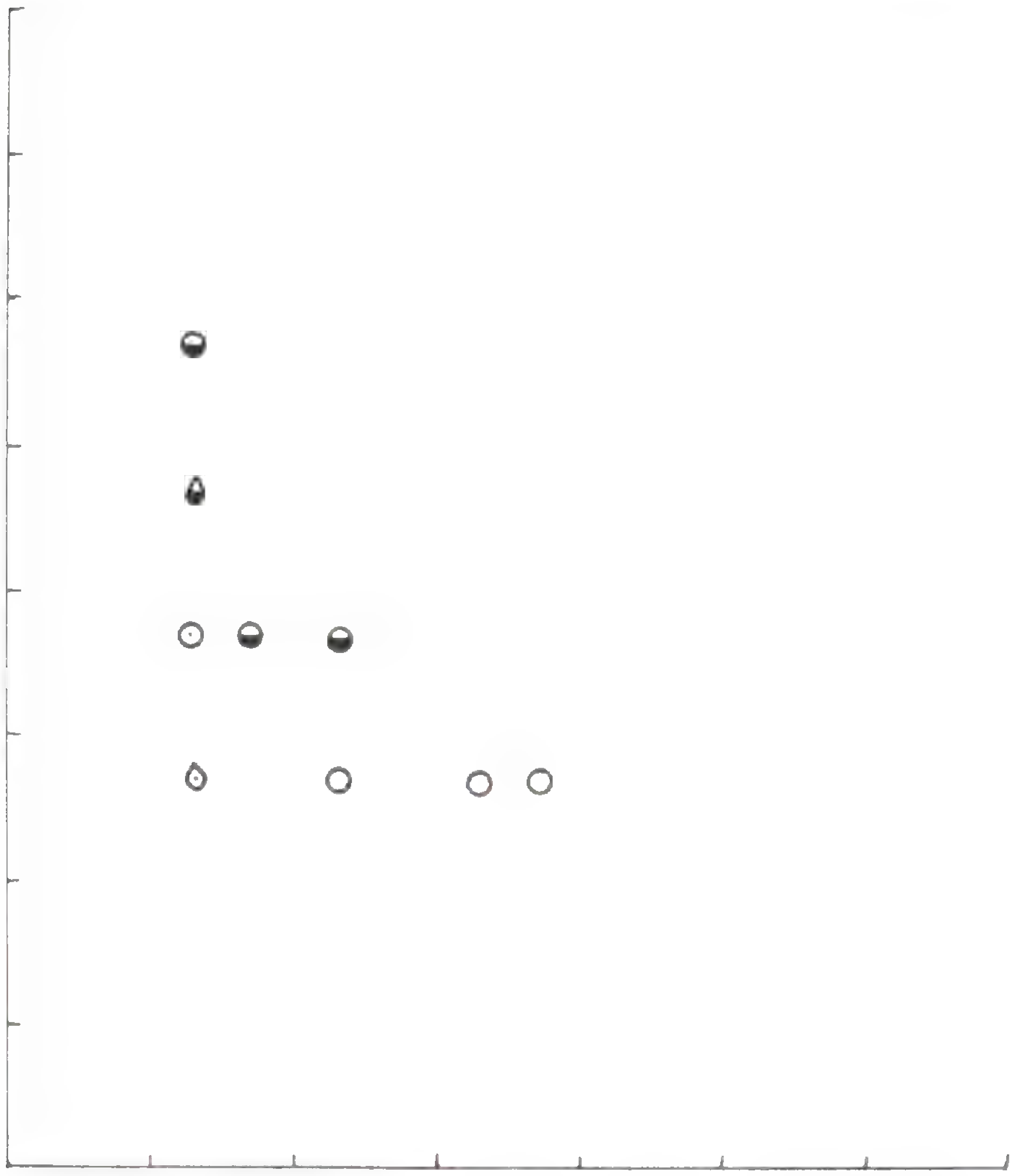
51. Zitácuaro, Michoacán

Collection by E. J. Wellhausen. Prevailingly white and pale yellow. Four of the ears had a faint reddish pericarp. Many of the ears were crooked in spite of being quite short. There is a slight error in this figure. Of the three ears indicated as having eight rows only the lower one was eight-rowed. The two others in the same square are really ten-rowed, and these two dots should have been slightly higher in the diagram.



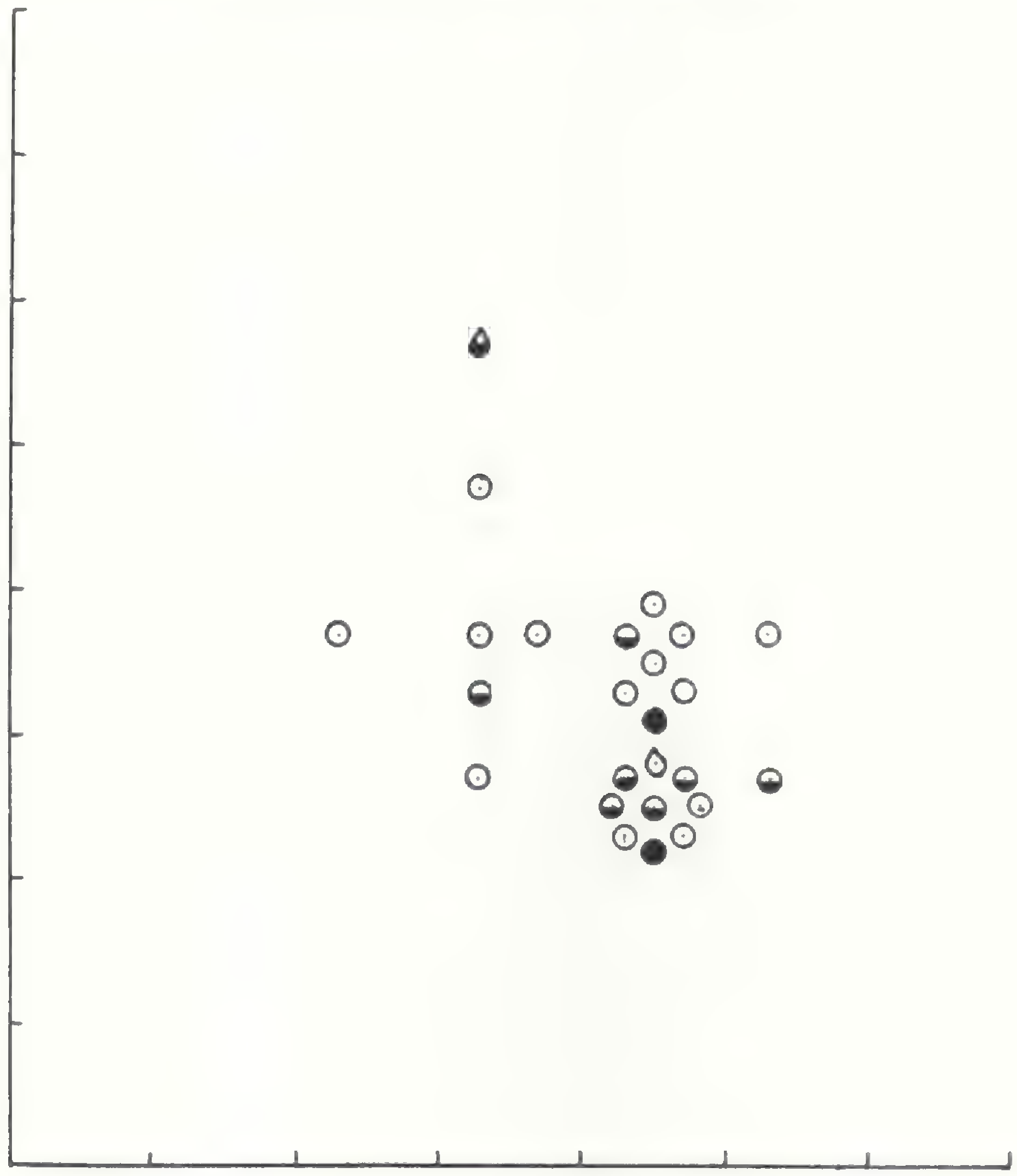
52. Quiroga, Michoacán. *Maíz de tierra fría*

Collection by E. J. Wellhausen. Prevailingly white and pale yellow with a few ears with faint pink pericarp.



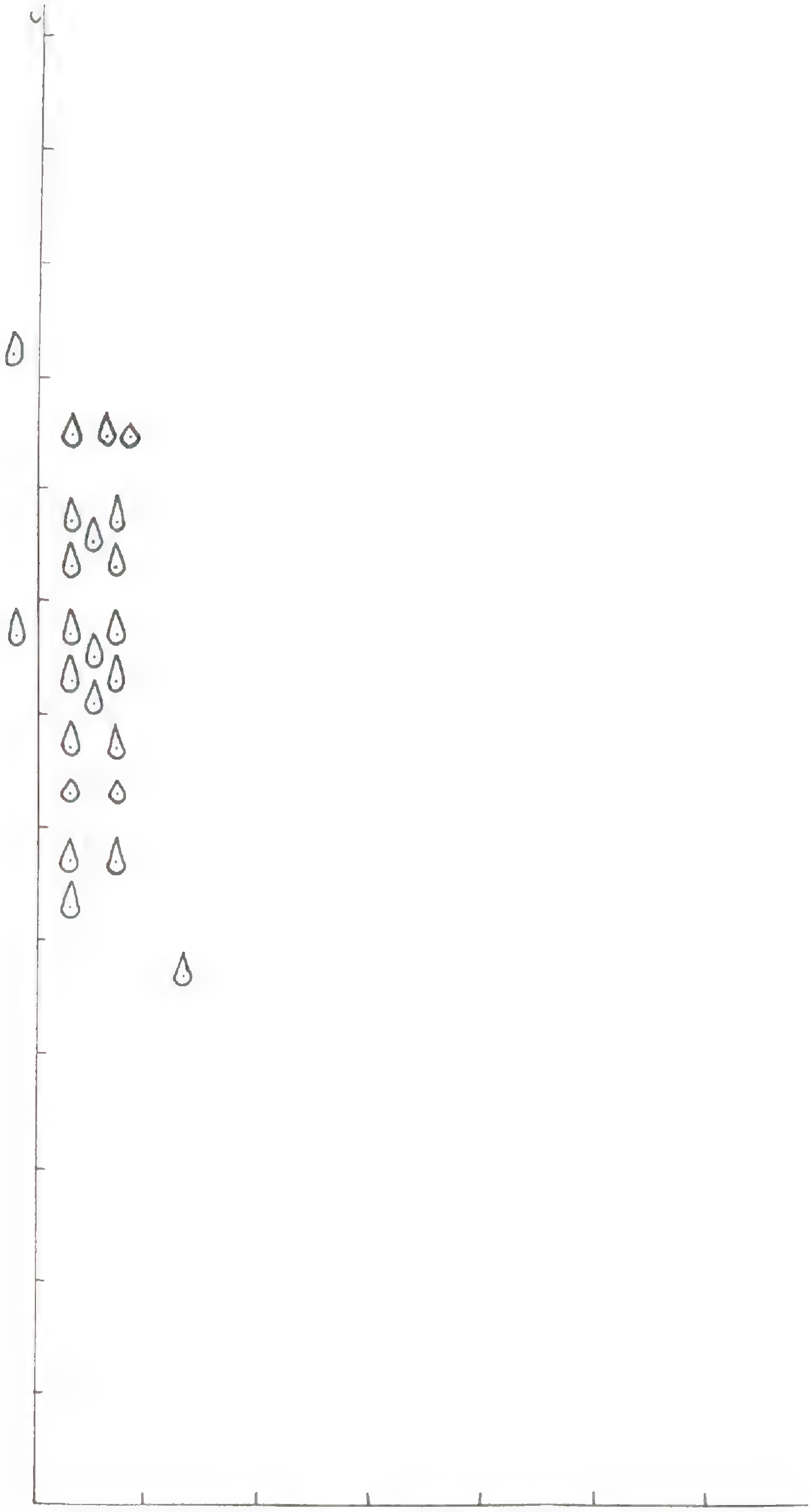
53. San Francisco, Villa Allende

A small collection made by Dr. Wellhausen. All dark aleurone *(Pr)*. On half the ears the color is intensified by red pericarp *(P* and P^{cr}*)* which makes the dark blue into a shiny black.



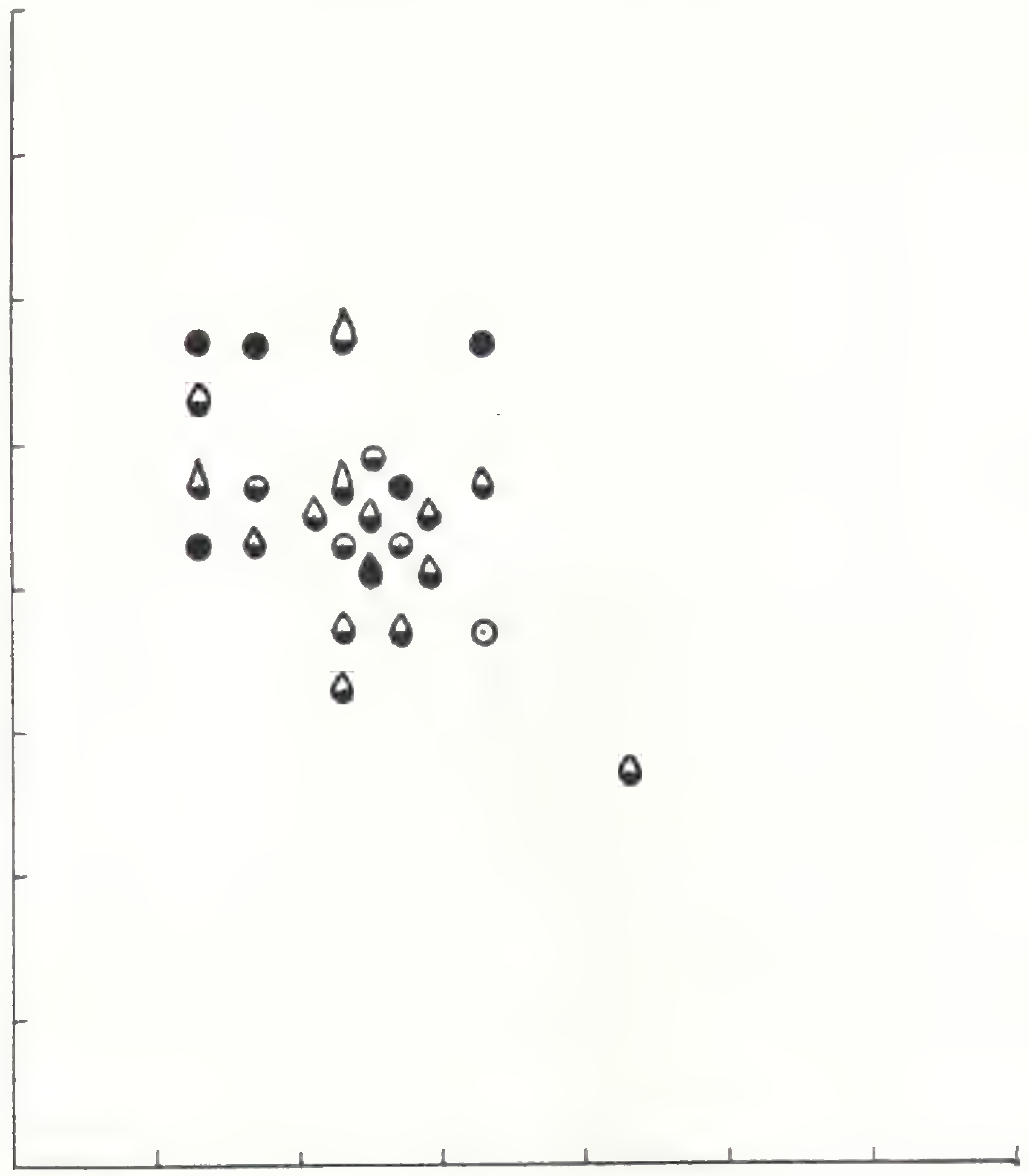
54. Mexico-Toluca Highway, Km. 60. *Cacahuazintle*

Nearly all pure white. One ear with five yellow kernels, all brilliant yellow and showing no capping of soft starch. Two ears with a few kernels of dark aleurone *(Pr)*; all of these very dark. Two ears shown in fig. 1, lower right. Two ears of this variety and from the same town are illustrated in fig. 1.



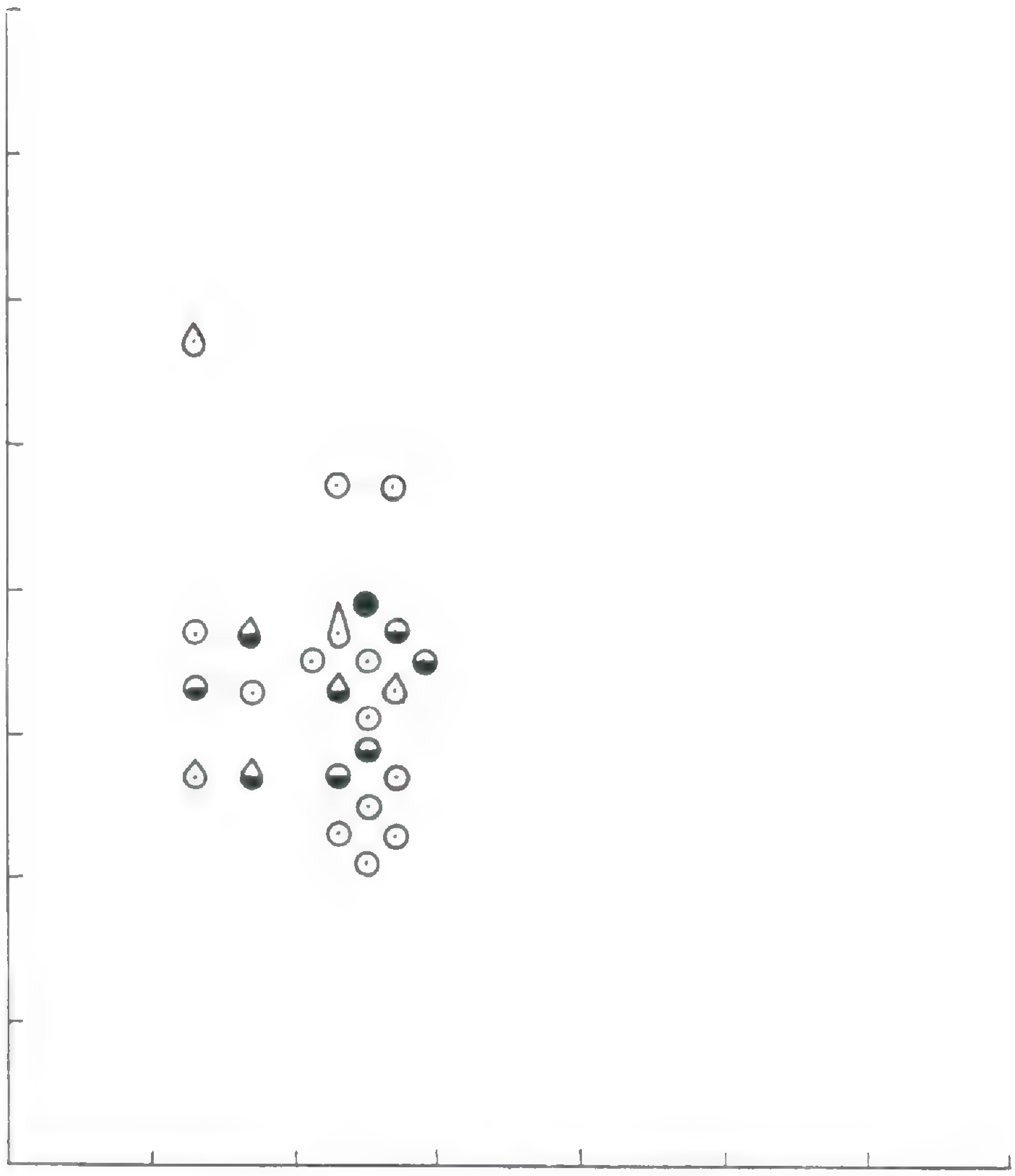
55. Mexico-Toluca, Km. 57

Prevailingly white endosperm, modified by the pinky tan and smoky colors of the pericarp. Three of the ears are strongly fasciated and look almost like "Japanese Hull-less" popcorn. One ear is illustrated in pl. 5, above. Note extension of vertical scale.



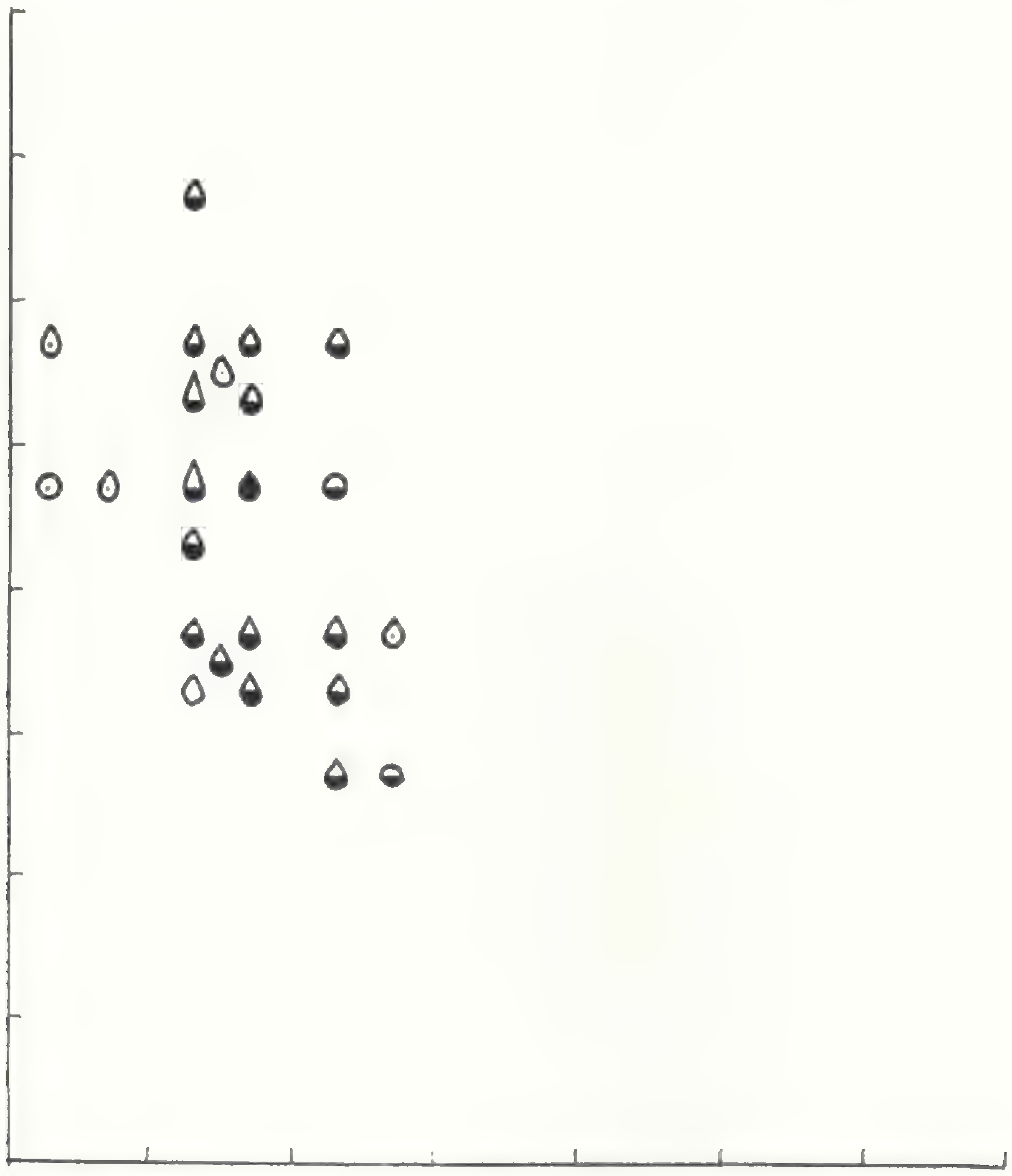
56. Mexico-Toluca, Km. 17

Collected by E. J. Wellhausen. Prevailingly white and light yellow. Four ears have a pinkish tan pericarp. One ear is strongly fasciated.



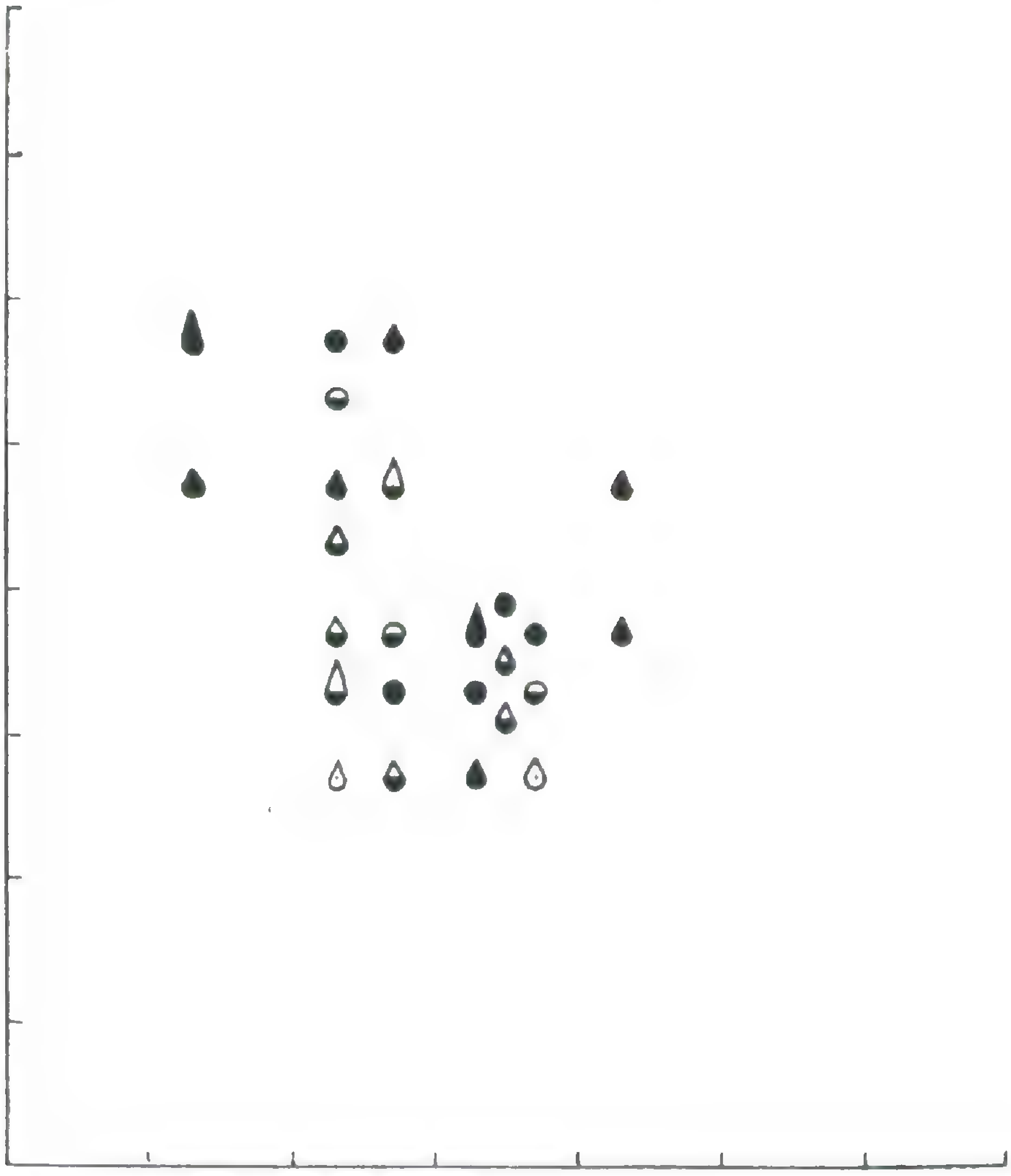
57. Mexico-Toluca, Km. 17

Collected by E. J. Wellhausen. Prevailingly bright yellow, with some light yellow and white. Two ears with a few kernels with dark aleurone *(Pr)*. Varying greatly from ear to ear in the amount of capping with soft starch.



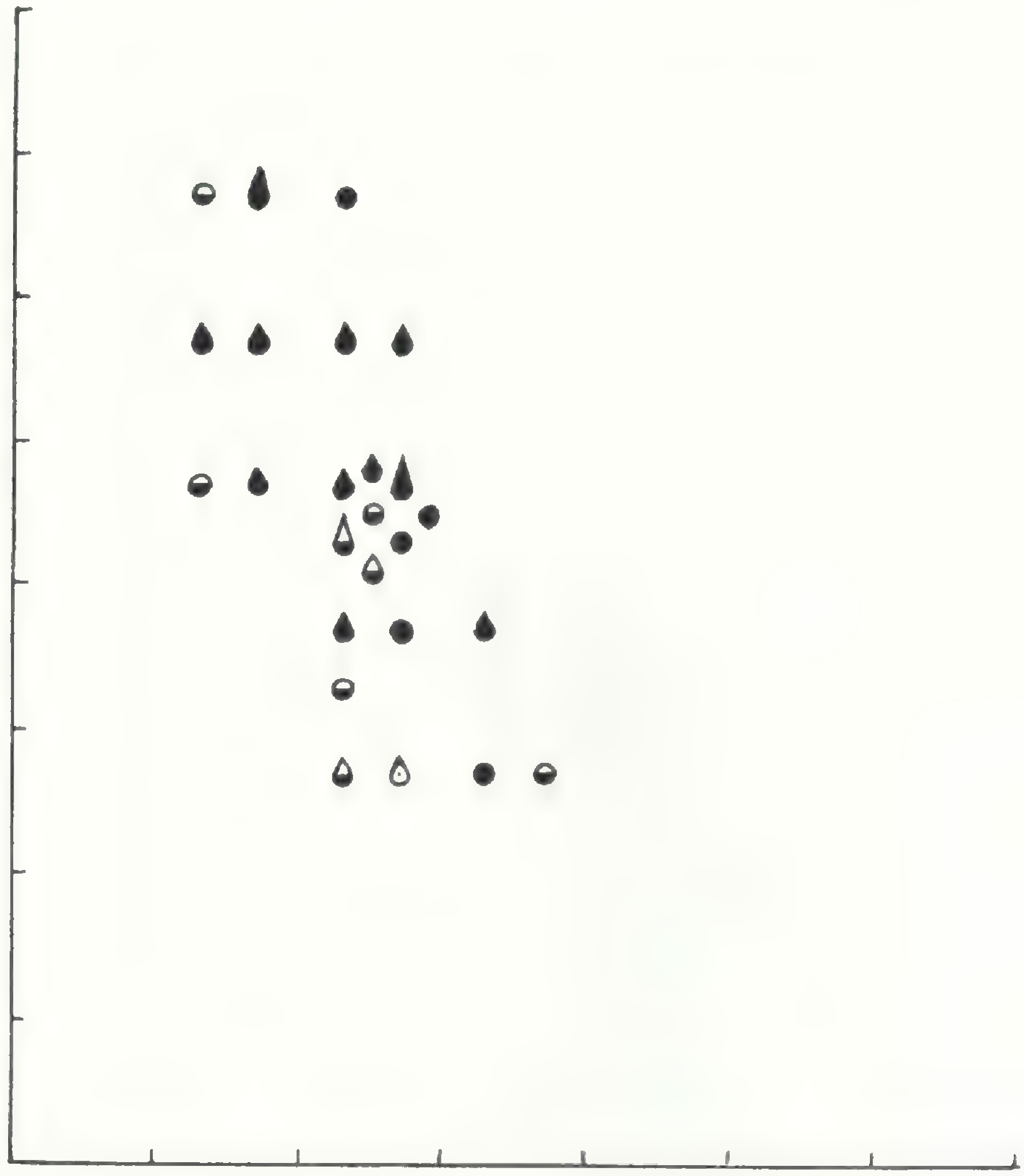
58. Mexico-Toluca, Km. 57 (Bag No. III)

Collected by E. J. Wellhausen. Prevailingly white and yellow, the latter mostly very pale. Many kernels with faint dark aleurone (probably *Pr* and a semi-dominant white).



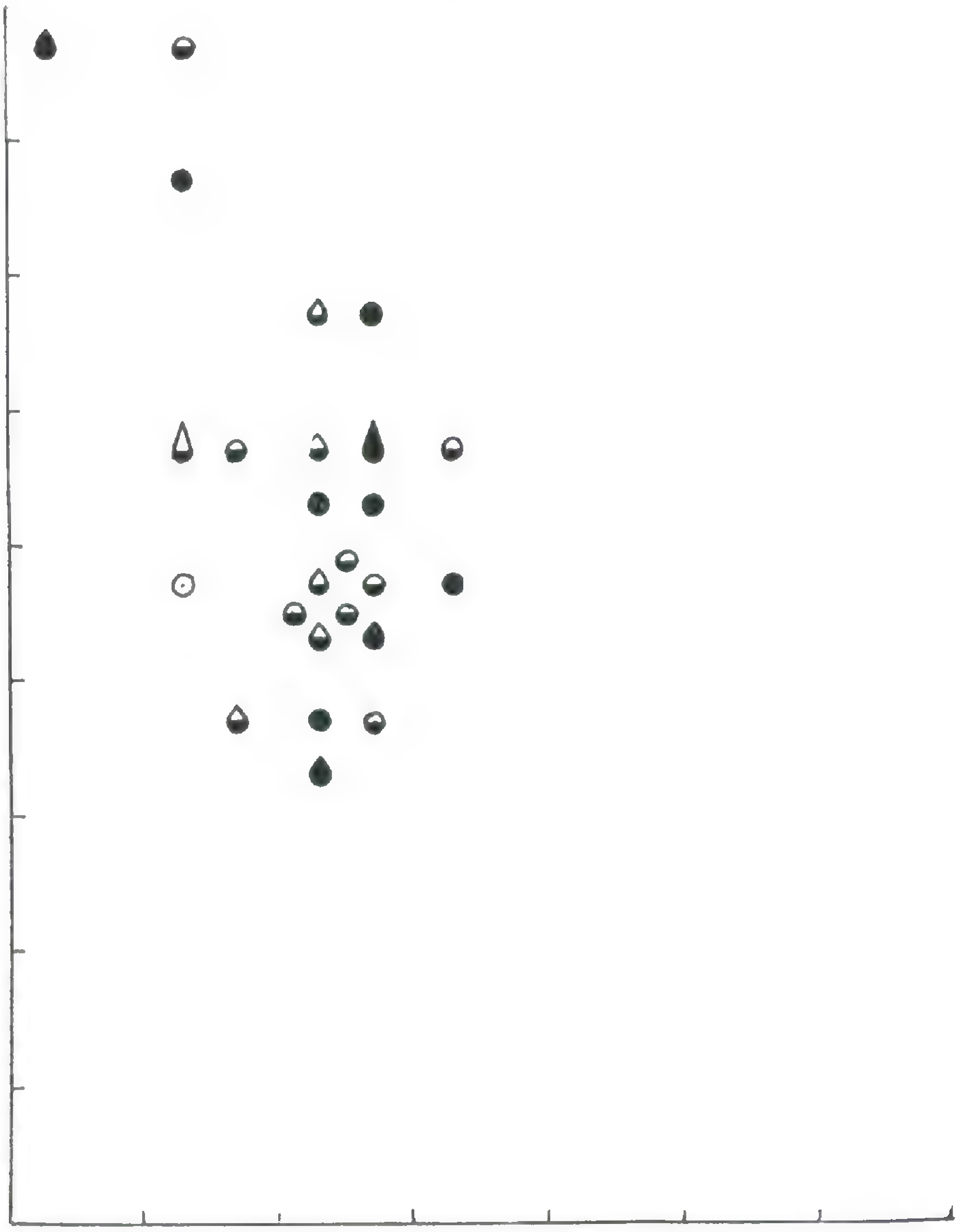
59. Chalco, Mexico

Collected by E. J. Wellhausen. All dark aleurone, one ear segregating for white. Most of the ears with occasional white or nearly white kernels. Six of the ears with red pericarp *(P* and P^{cr}*)*.



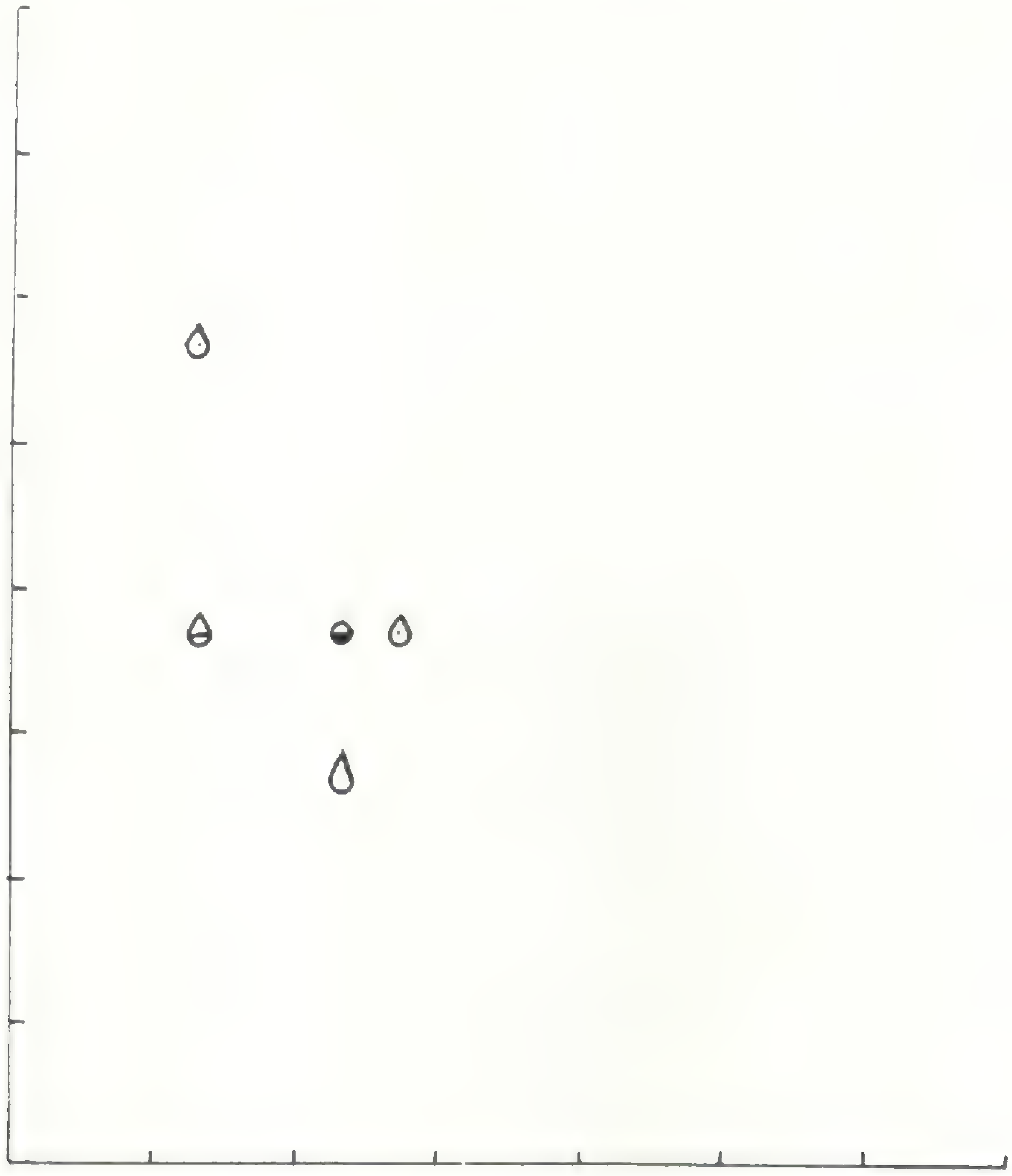
60. Metepec

Collected by E. J. Wellhausen. All white and light ivory yellow.



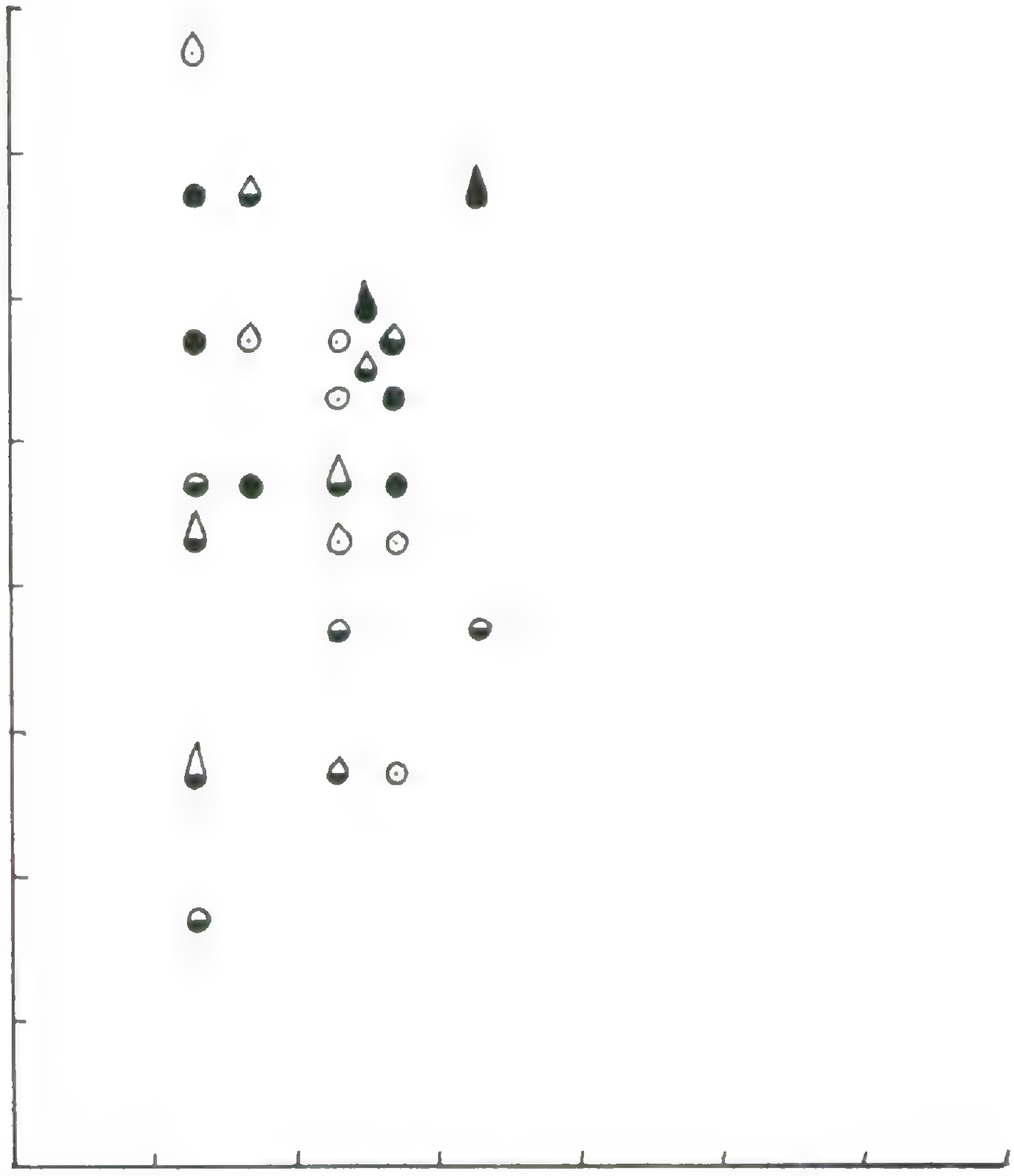
61. Tepotzotlán, Mexico

Prevailingly white and light ivory yellow. Two ears with pericarp color.



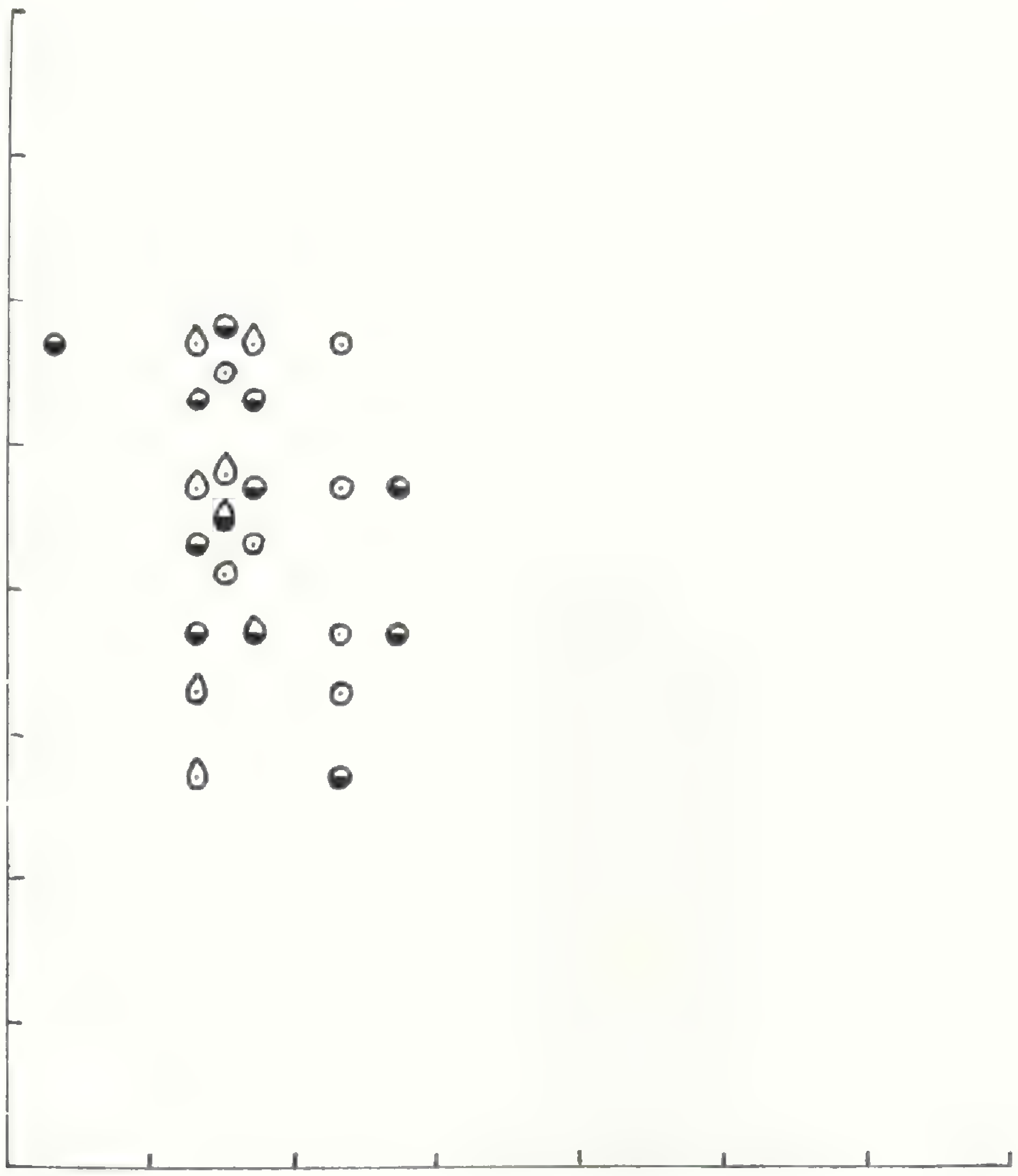
62. Tepotzotlán, Mexico

Small samples of two early varieties used for *pinole* and *elotes*.



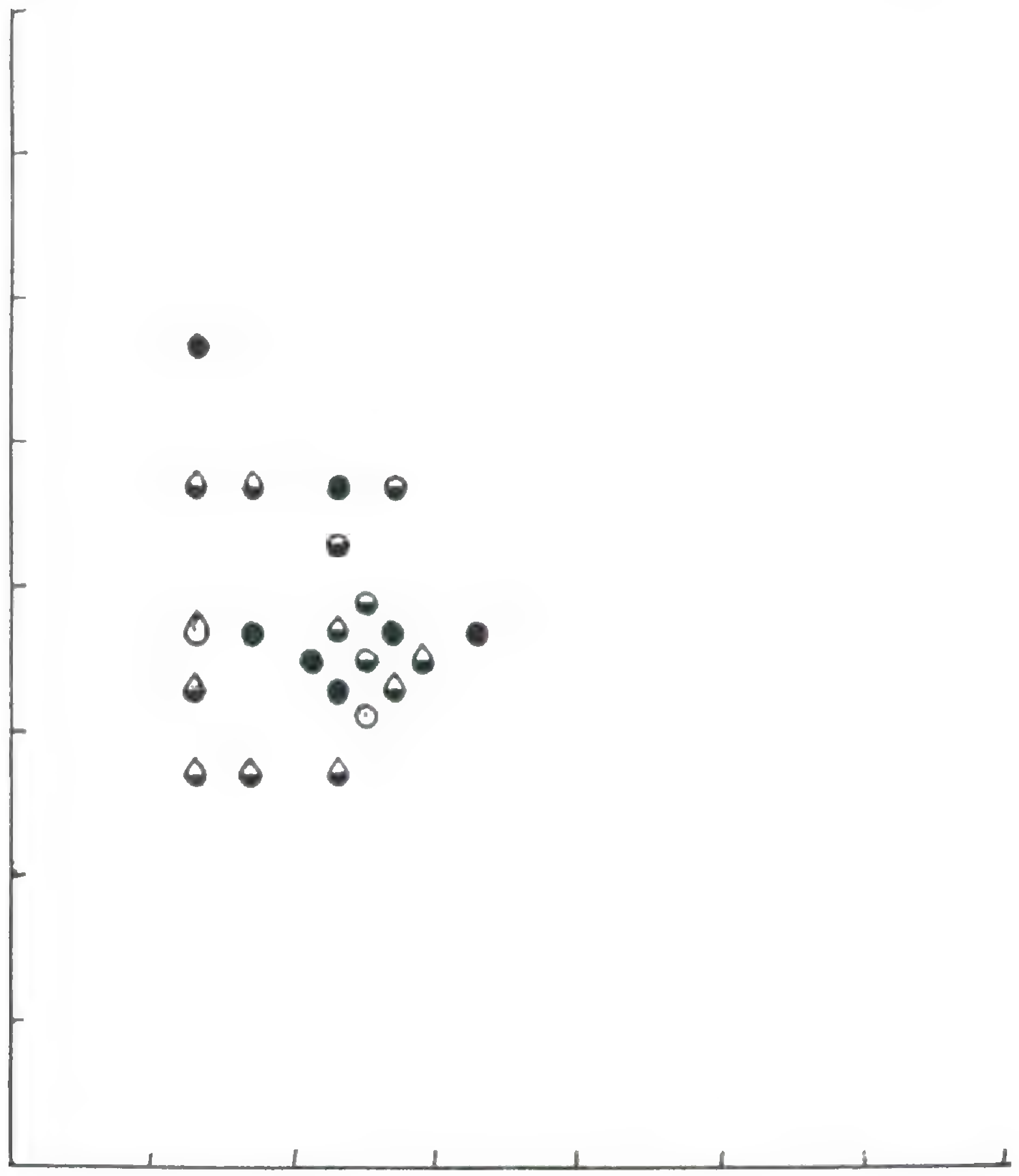
63. Huehuetoca, Mexico. *Maíz blanco*

Nearly all white. Four ears showed a few kernels with dark aleurone *(Pr)*. The ears photographed are the superior ones and not a random sample.



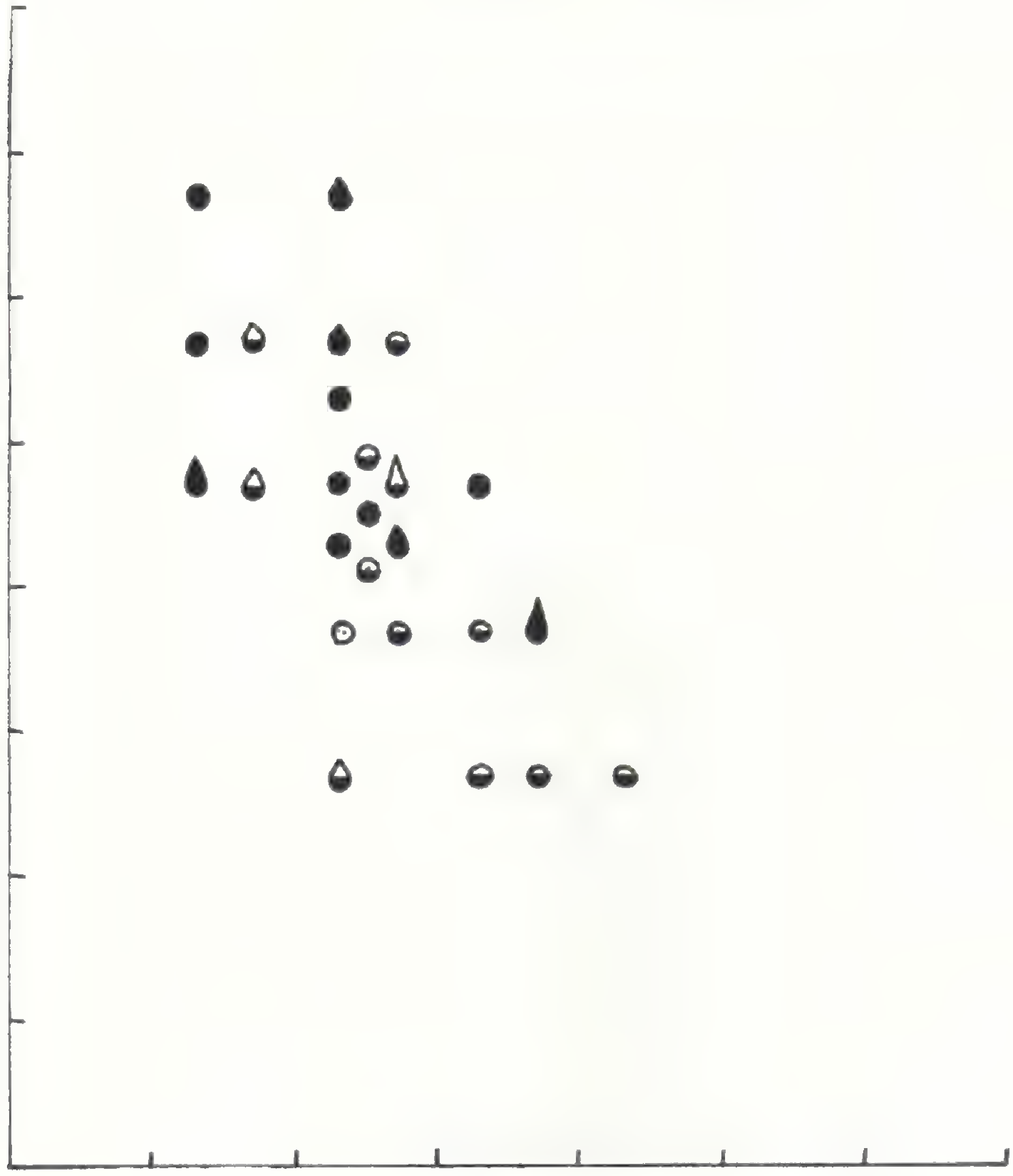
64. Acupula, Mexico. *Maíz morado apastillado*

Predominantly reddish aleurone *(pr)*, though every ear showed a few *Pr* and two ears were largely so. Most of the ears with a few white kernels (C^i). Two ears with red pericarp. Said to be early seasoned. One ear illustrated in pl. 5, right below.



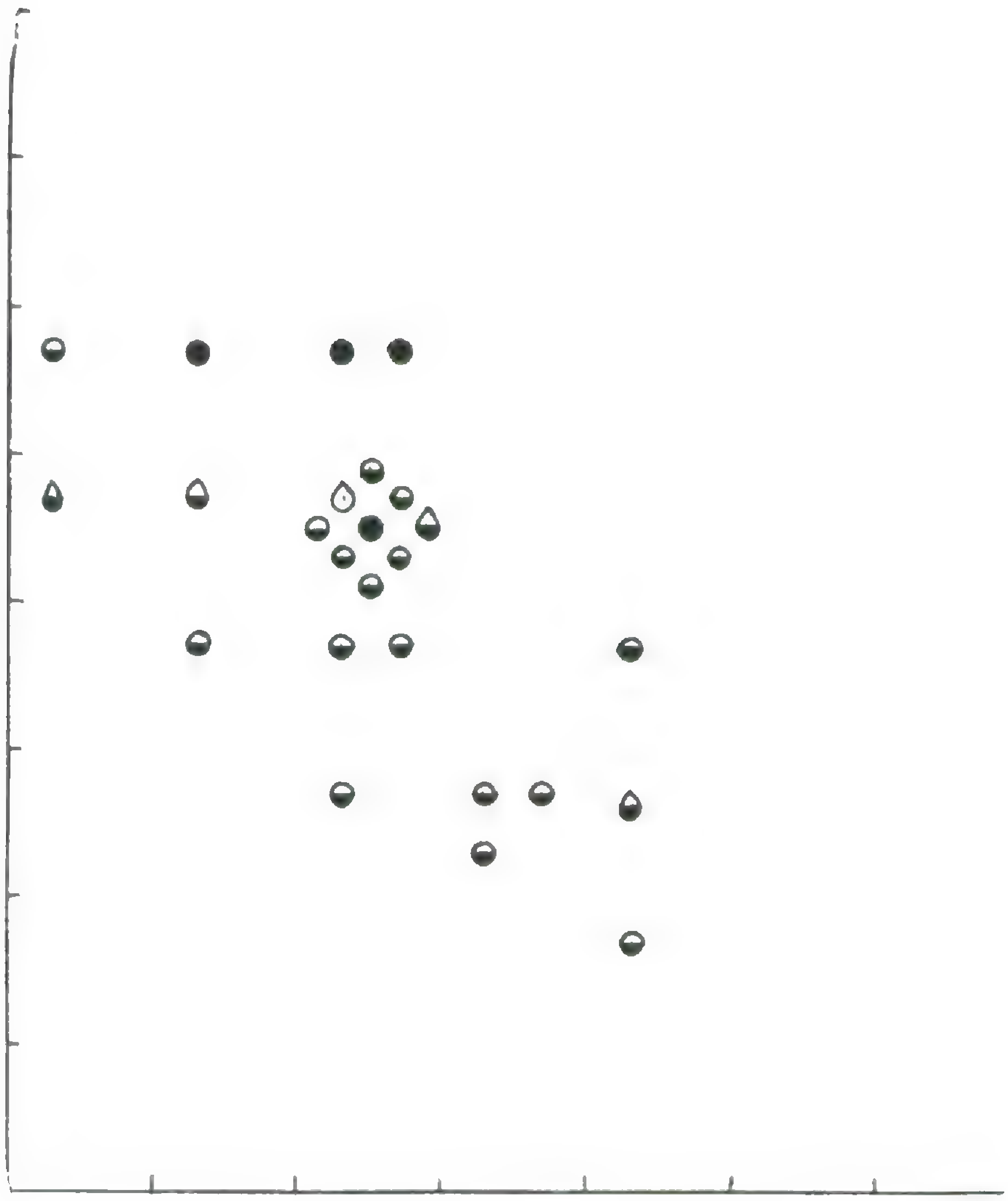
65. Huehuetoca, Mexico. *Maíz negro*

Prevailingly *Pr*. Many of the ears with a few kernels of clear white, indicating the probable presence of dominant white (*C'*).



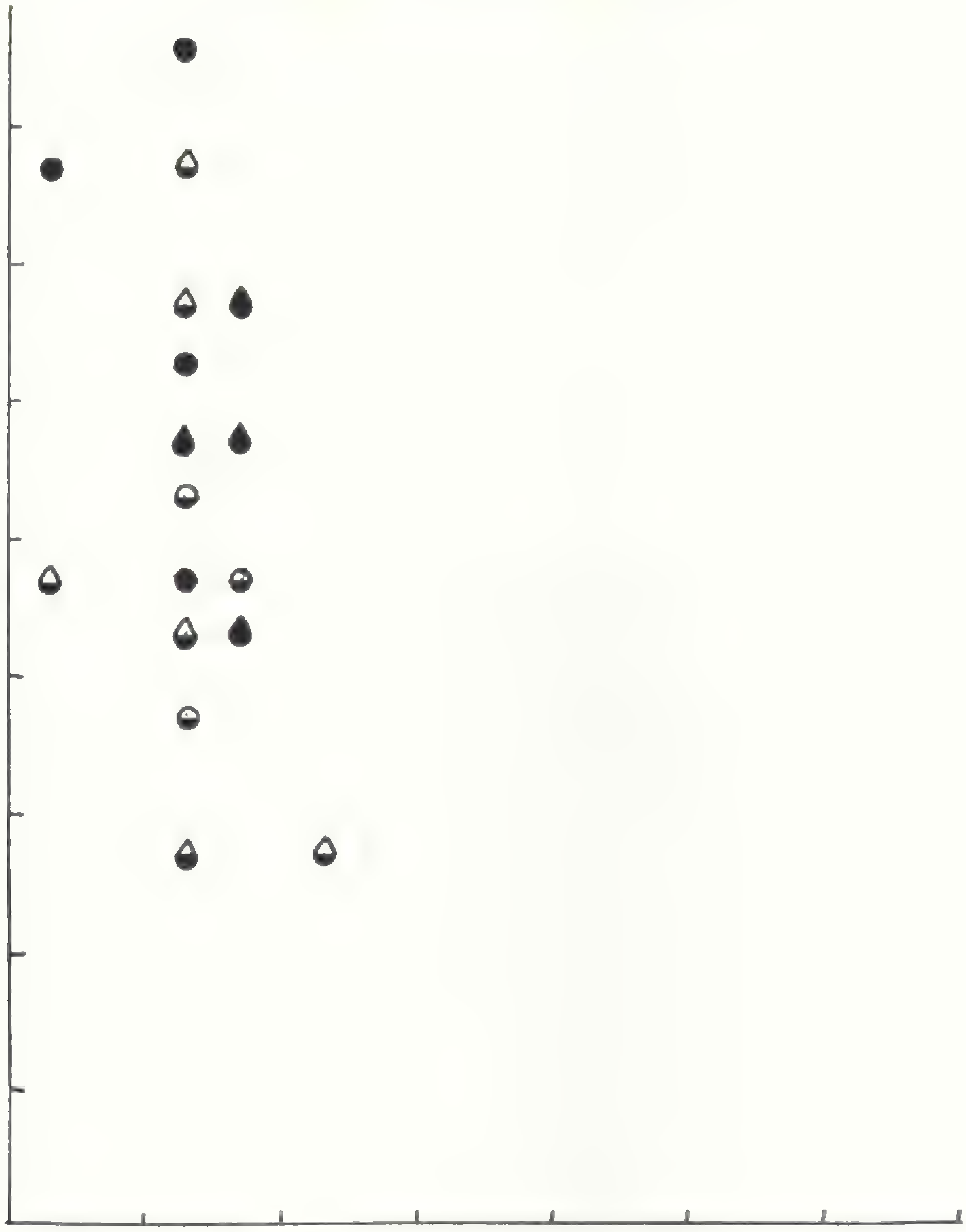
66. León, Gto. *Maíz vaquereño, tipo I*

An improved variety produced by Sr. Eduardo Limón. White with heavy capping of soft starch.



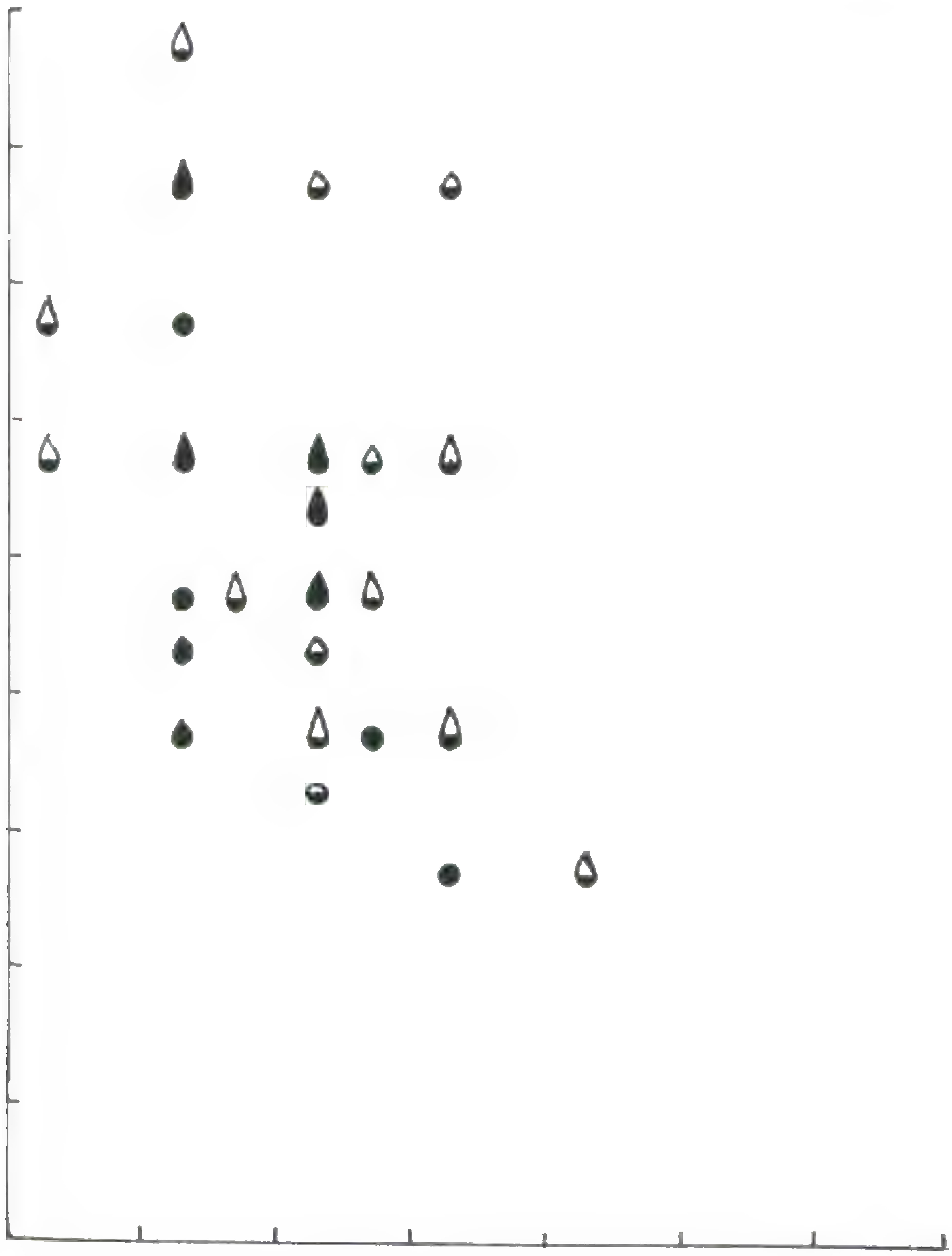
67. León, Gto. *Maíz vaquereño*

A collection made from several small farmers in the neighborhood. It represents the original type from which Sr. Limon made his selections and is therefore representative of the maize of the "Bajio," the Mexican corn belt. Prevailingly white and heavily capped with soft starch. A few ears with yellow kernels.



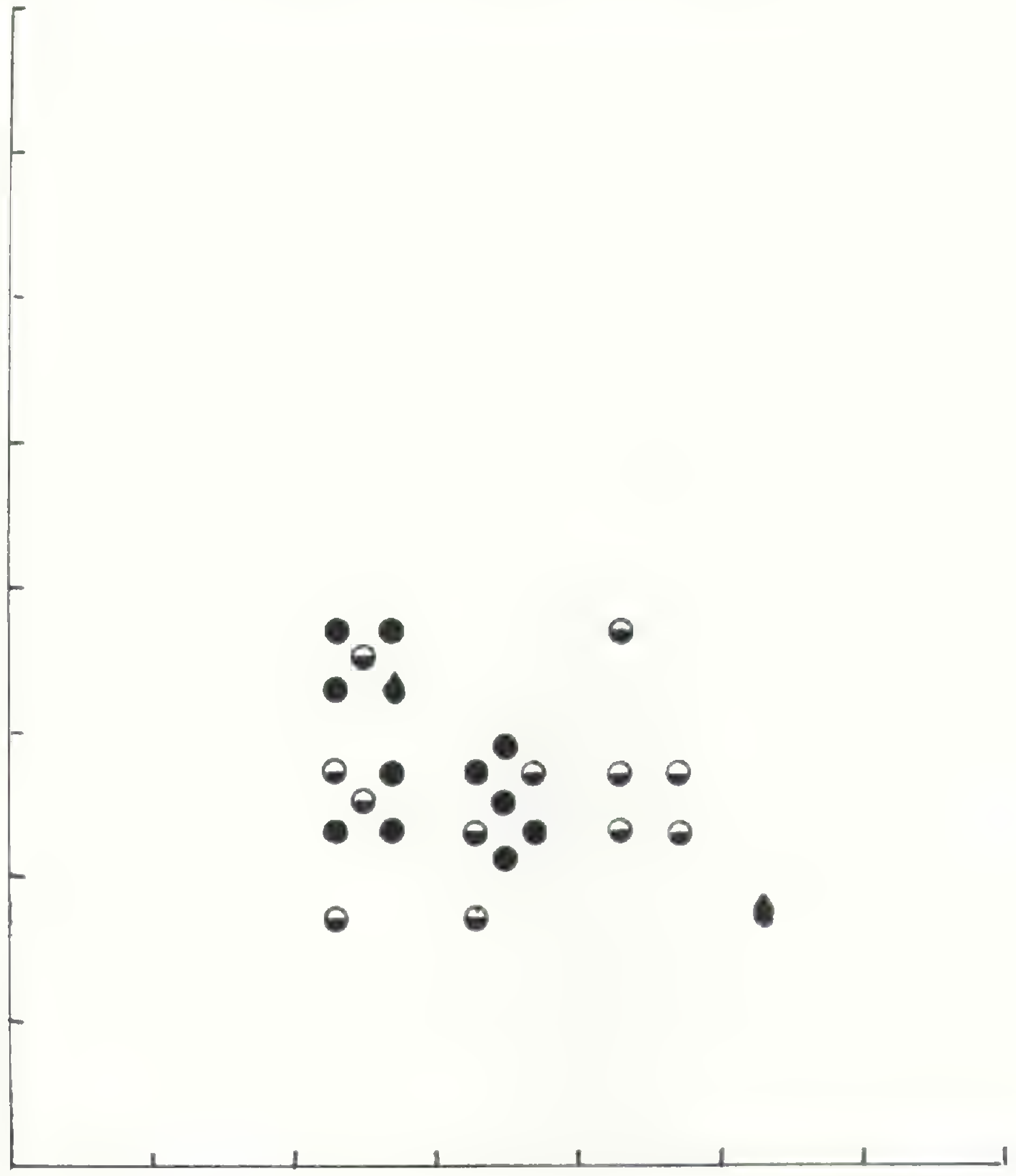
68. Salamanca, Gto. *Maíz blanco*

A collection made by E. J. Wellhausen. All white, with a strong tendency to fasciated ears. There is a slight difference in scale in this figure. On the vertical scale the row numbers run from 10 to 26 instead of 8 to 24 as in the other plates. The entire figure should be pushed upwards one unit to make the grid correspond to all the others. Horizontal scale unchanged.



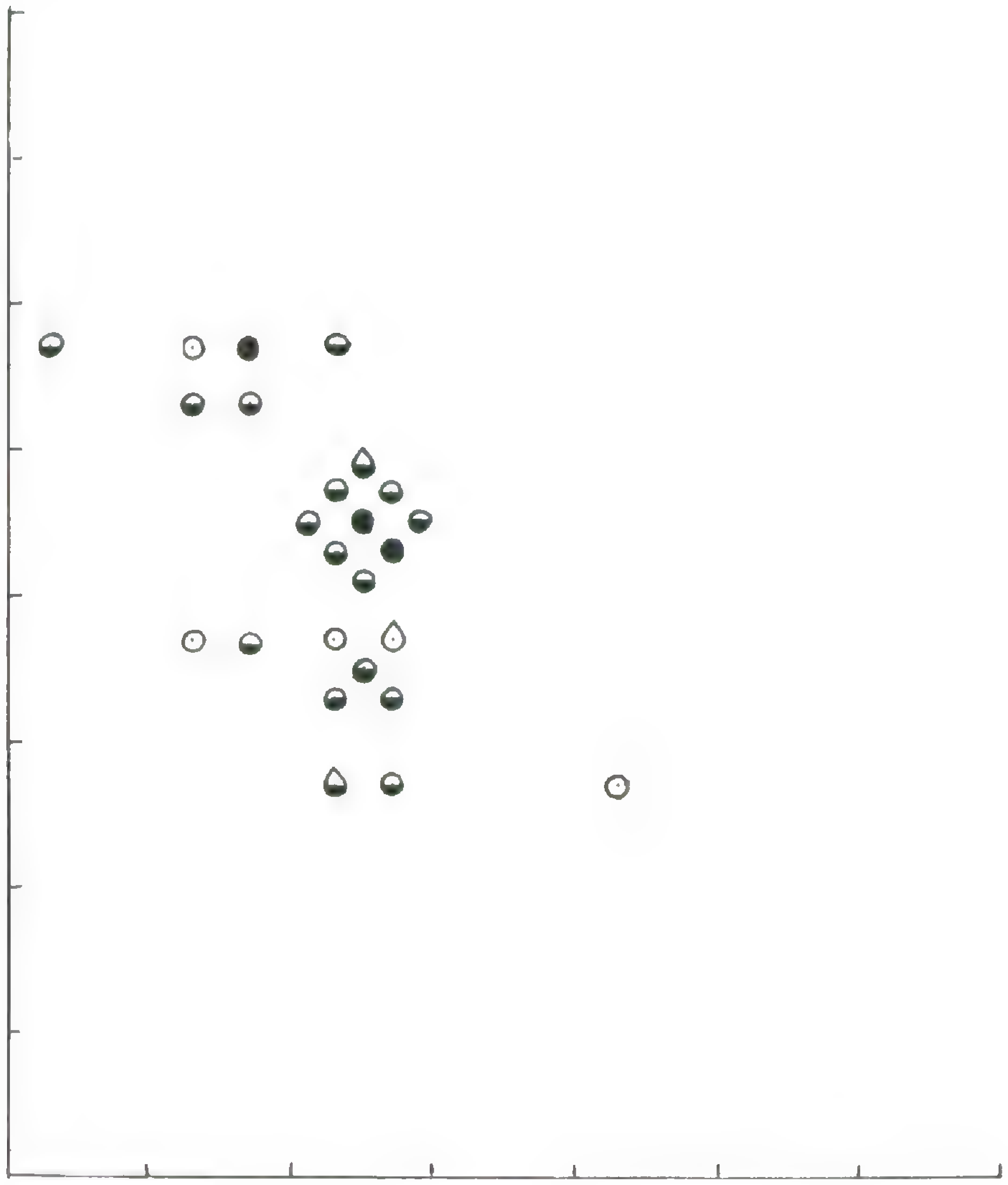
69. Tlaltizapán, Morelos. *Maíz pipitillo*

White and light yellow. One of the extreme ears is illustrated in plate 4, below. None of the extreme type with long, pointed kernels showed any yellow stronger than a pale ivory. The less pointed kernels (of the type known as *maiz perla*) nearly all showed light yellow kernels here and there. It seems probable that the extreme "pipitillo" has a strong yellow-inhibitor.



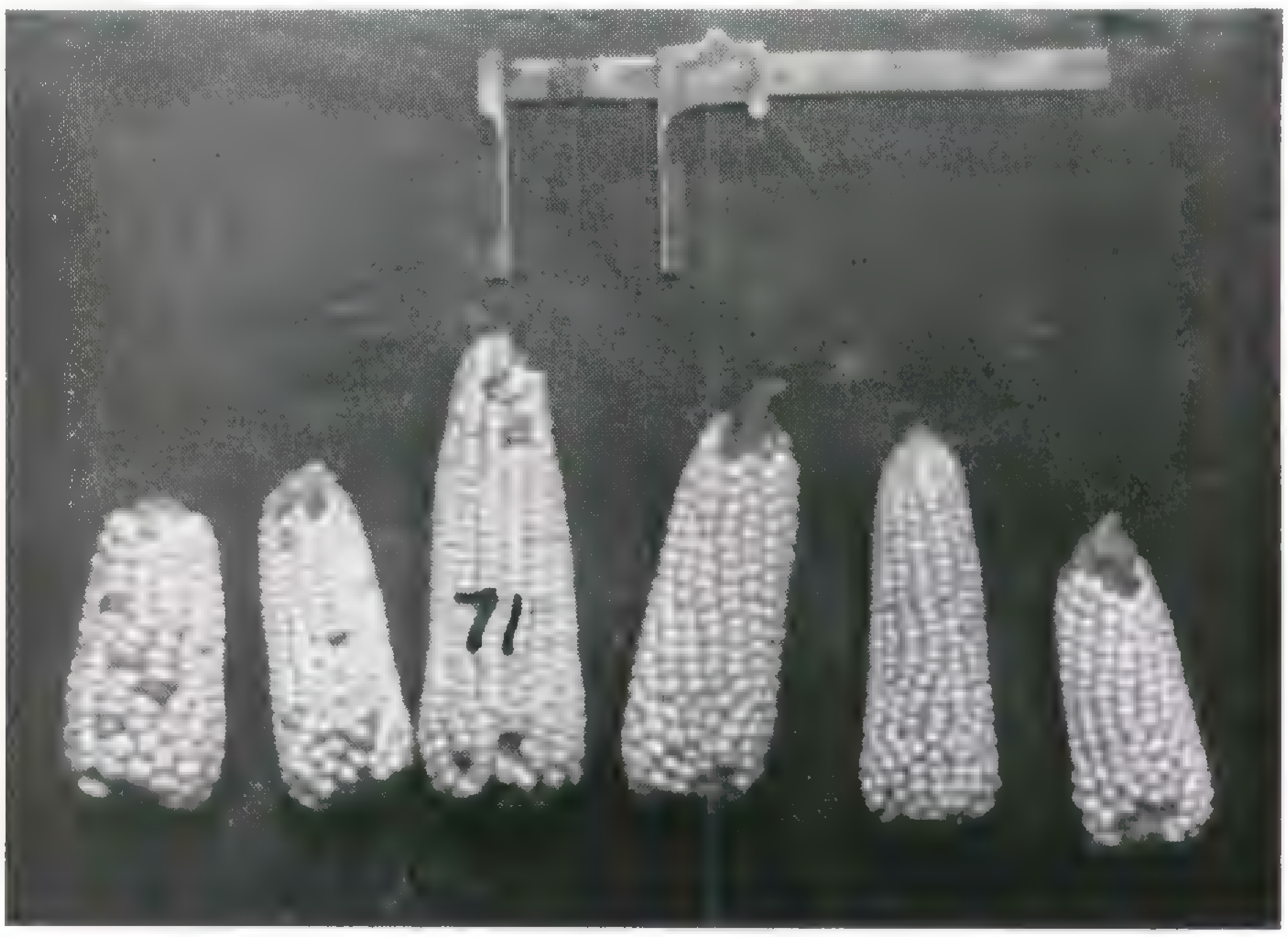
70. Tlaltizapán, Morelos. *Maíz colorado*

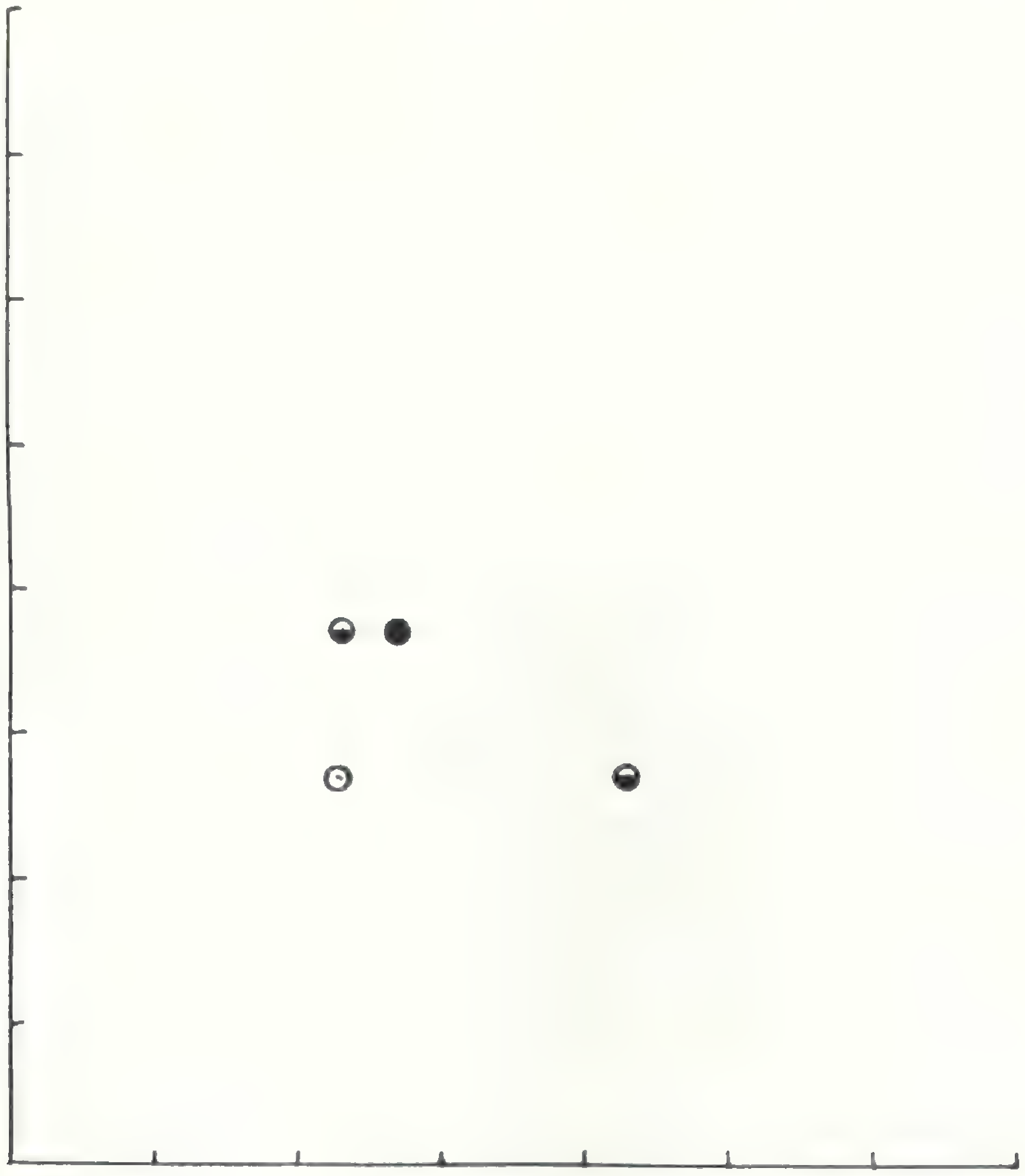
Prevailingly *pr* with several ears showing *Pr* and a few with white kernels. All were red-cobbed.



71. Otlatlán, Puebla. *Cacahuazintle*

Obtained through R. H. Barlow from a remote mountain village. Prevailingly white with many kernels of yellow and of dark aleurone *(Pr)*. Obviously extensively mixed with the local white corn, samples of which were also obtained.





72. Chihuahua

Obtained through E. J. Wellhausen. White and yellow. Very similar to the maize of the pueblo Indians in Arizona and New Mexico and probably derived therefrom. This conclusion is supported by unpublished archaeological evidence from several sources.

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A CYTOLOGICAL STUDY OF YEAST *(SACCHAROMYCES CEREVISIAE)*[1]

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Introduction

A century ago Nägeli (1844) first described the yeast cell as having "a little nucleus of whitish mucus, lying on the membrane." From that time to this the cytology of yeast has been a subject of controversy. Extensive bibliographies and discussions of the earlier literature may be found in Wager ('98), Wager and Peniston ('10), Guilliermond ('20), Moore ('33), and Badian ('37). Brandt ('41) has reviewed the more recent literature, as well as given the results and interpretations of his own extensive investigations. Recently Lindegren ('45) and Subramaniam and Ranganathan ('45, '46a, '46b) have published differing interpretations of nuclear organization in yeast.

In spite of the great amount of work which has been done on the cytology of yeasts, there is still no general agreement (Table VI) among students of the subject even on fundamental points. There are several reasons for this lack of agreement: (1) The most important is the small size of the yeast cell which makes accurate observation of details extremely difficult and causes interpretation to be more or less speculative. (2) The use of only one or two stain techniques by many investigators has increased the confusion because interpretations are based on incomplete information. (3) Until the work of Winge and his associates ('35, '37) investigators were handicapped by lack of understanding of the life cycle of yeasts. (4) Not until the recent work of Lindegren and Lindegren ('44) was it possible for a cytologist to secure adequate sporulating material.

The present work was undertaken with the hope that additional information could be gained concerning the structure of the yeast cell through the thorough and methodical use of a variety of techniques on the excellent material available from the Lindegren laboratory.

[1] An investigation carried out in the graduate laboratory of the Henry Shaw School of Botany of Washington University, assisted by a grant from Anheuser-Busch Inc., and submitted as a thesis in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

Material

Saccharomyces cerevisiae was used in all of the work reported in this paper except as noted below. The cultures were secured from the Lindegrens, and all culture designations refer to their material. Most work was done with the diploids LK, with the hybrids EFF, 30 x 20 cc., and with BC20—, and several similar haploids. EFF is a hybrid of three commercial baking yeasts; LK is isolated from a Canadian pressed yeast. The haploid BC20— is a single ascospore isolate from a strain studied by the Lindegrens as were the other haploids used.

While working on the identification of wild yeasts found on native fruits obtained from the Missouri Botanical Garden Arboretum, an especially large one which showed peculiar multiple budding was isolated. It is probably an undescribed species of *Syringospora* or a related genus. Limited cytological observations were made on it for comparison with *Saccharomyces cerevisiae*. A few observations were also made on a species of *Cryptococcus* (?), another wild yeast.

Methods

In so far as possible all techniques and observations were carried out with all material used; that is, a general systematic survey was attempted. Parallel observations of living material were also made.

Culture Methods.—Budding cells of various diploid cultures were sometimes obtained from yield tests in the Lindegren Laboratory (Lindegren and Lindegren, '43). Both haploids and diploids were also cultured in liquid nutrient medium

TABLE I

PROCEDURE FOR SECURING SPORULATION
(LINDEGREN AND LINDEGREN, '44)

Time	Medium			Technique
	Kind	Formula	Method of Preparation	
48–72 hrs.	Presporulating	Beet (leaves) extract ....10 cc. Beet (roots) extract......20 cc. Apricot juice ....35 cc. Grape juice ....16½ cc. Yeast (dried) ....2 gm. Glycerin ....2½ gm. Agar ....3 gm. $CaCO_3$ ....1 gm. Water—to give 100 cc. final volume	Steam mixture 10 minutes. Tube and autoclave. Slant.	Streak on slant; incubate at 25° C. (room temp.). After 2–3 days pour 1 cc. sterile water over yeast. Stir to make thick suspension of cells. Take up in sterile pipette.
16–48 hrs.	Gypsum slant	Water ....100 cc. Plaster of Paris ....100 gm.	Mix, pour, and slant rapidly. Dry 24 hours at 50° C. Autoclave.	Pour over upper part of gypsum slant. Pipette 3–4 cc. sterile water containing enough acetic acid to bring it to pH 4.0 into lower half of slant. Incubate at 25° C.

and on nutrient agar slants. Little work was done with copulating yeast cells or with old or starved cultures.

Material for the study of stages of sporulation was cultured in accordance with the method developed by the Lindegrens on medium supplied by them (Table I). The diploid strains LK and EFF were usually used because they sporulate well.

Smear Technique.—All permanent preparations were made as smears on cover glasses and stained in cover glass Coplin jars (cover glass wells of Thomas & Co.). The yeast cells were stuck to the cover glass with a thin coating of Mayer's albumen fixative or applied directly to a thoroughly cleaned cover glass. The cover glasses with the layer of albumen were generally heated gently over an alcohol burner "until a gray smoke is given off" as suggested by La Cour ('41) before applying the cells. Many more cells remained on the cover glass if fixative was applied, but with some techniques the albumen tended to stain and if drying occurred artifacts frequently appeared. Many cells were lost in succeeding operations if applied directly to the cover glass.

For applying the yeast to the cover slip a micropipette was found useful. An ordinary glass dropper was heated just above the narrow end, drawn out thin, cut off to a length of seven or eight inches, and the rubber bulb replaced. A very small drop of water was placed on the cover glass with the micropipette and cells were added from a slant with a sterile loop; in other cases a droplet of cells was pipetted onto the cover slip from a suspension. The cells were spread evenly by passing the thin flexible end of the micropipette across the surface of the cover glass. This was done rapidly to avoid drying, which causes severe distortion of the cells. The cover glasses were immediately floated cell-side down on the surface of the fixing solution in a Petri dish. If long fixation was required, they were transferred after about fifteen minutes to a cover glass Coplin jar for convenient storage.

Fixation and Staining Procedures.—Many different fixations were tried, and the types which apparently caused least shrinkage, distortion of the vacuole, and granulation of the cytoplasm were generally used (Table II). Drying, even after fixation, tended to cause shrinkage and distortion. Good fixation was apparently related in part to the condition of the cells; fresh, actively growing cells showed better fixation than old cells from giant colonies, and actively budding cells better than the highly granular sporulating cells. None of the methods used was completely satisfactory.

The general staining procedures are outlined in Table III. A further discussion of outstanding points is given in the following section of the paper.

TABLE II

FIXATION*

Fixative	Formula and/or Modifications	Time	Evaluation
Mercuric chloride	Saturated aqueous $HgCl_2$ + 0.5 –1.0% glacial acetic acid	½–24 hrs.	Most satisfactory general fixation
Iodine-formalin-acetic acid	1% iodine in 1% KI..20.0 cc. Formalin 40% .... 4.0 cc. Glacial acetic acid ...... 0.5 cc. Distilled water ....5–10.0 cc.	12–24 hrs.	Good with Giemsa technique (2, Table III)
Navashin	Plant tissue formula (Lee, '37) "Craf" Modification (Johansen, '40)	1–12 hrs.	Fair. Distortion of vacuole common
Osmic acid vapor	Vapor from 1% osmic acid solution	3–5 min.	Fair. Cytoplasm granular, vacuole often distorted or invisible
Picric acid	Saturated in distilled water or 70% alcohol	½–12 hrs.	Fair with methylene blue-eosin technique (7, Table III)

*Other fixations tried but not used because of distortion, shrinkage, and/or granulation of the cytoplasm were Carnoy, Carnoy-Lebrun, Perenyi, Flemming's weak solution, Uranium fixative (Semmens, '42), Picro-formol-acetic acid mixtures, glacial acetic acid vapor, chrome-Bowen-urea fluid, and alcohol both alone and in various combinations.

TABLE III

STAINING METHODS EMPLOYED IN THE STUDY OF THE YEAST CELL*

Stain	Usual fixation	Staining procedure	Remarks
1. Feulgen (Johansen, '40; de Tomasi, '36; Coleman, '38)	Mercuric chloride Navashin (Unnecessary to wash out fixing solution before hydrolysis—Bensley & Bensley, '38)	1. Hydrolyze 7–8 min, in 1 *N* HCl at 60° C. (Hillary, '39). 2. Stain 4–5 hrs. in Feulgen. 3. Wash 10 min. in each of three HCl-$K_2S_2O_3$ baths.	Feulgen positive body present in all cells. Cytoplasm clear and colorless.
2. Robinow's bacterial Giemsa (Robinow, '42; Dubos, '45)	Mercuric chloride Iodine Osmic vapor	1. Hydrolyze in 1 *N* HCl at 60° C. 7–10 min. 2. Stain in Giemsa (1 drop stain per ml. dilute buffer— pH 6.9–7.0) 15–45 min. 3. Pass through acetone-xylol mixtures as follows: 20:1 .... 4–30 sec. 14:6 ....10–30 sec. 6:14 ....10–15 sec. Pure xylol ....10–15 min.	Very good; apparently stains Feulgen positive body and gives stronger contrast and differentiation.

TABLE III (continued)

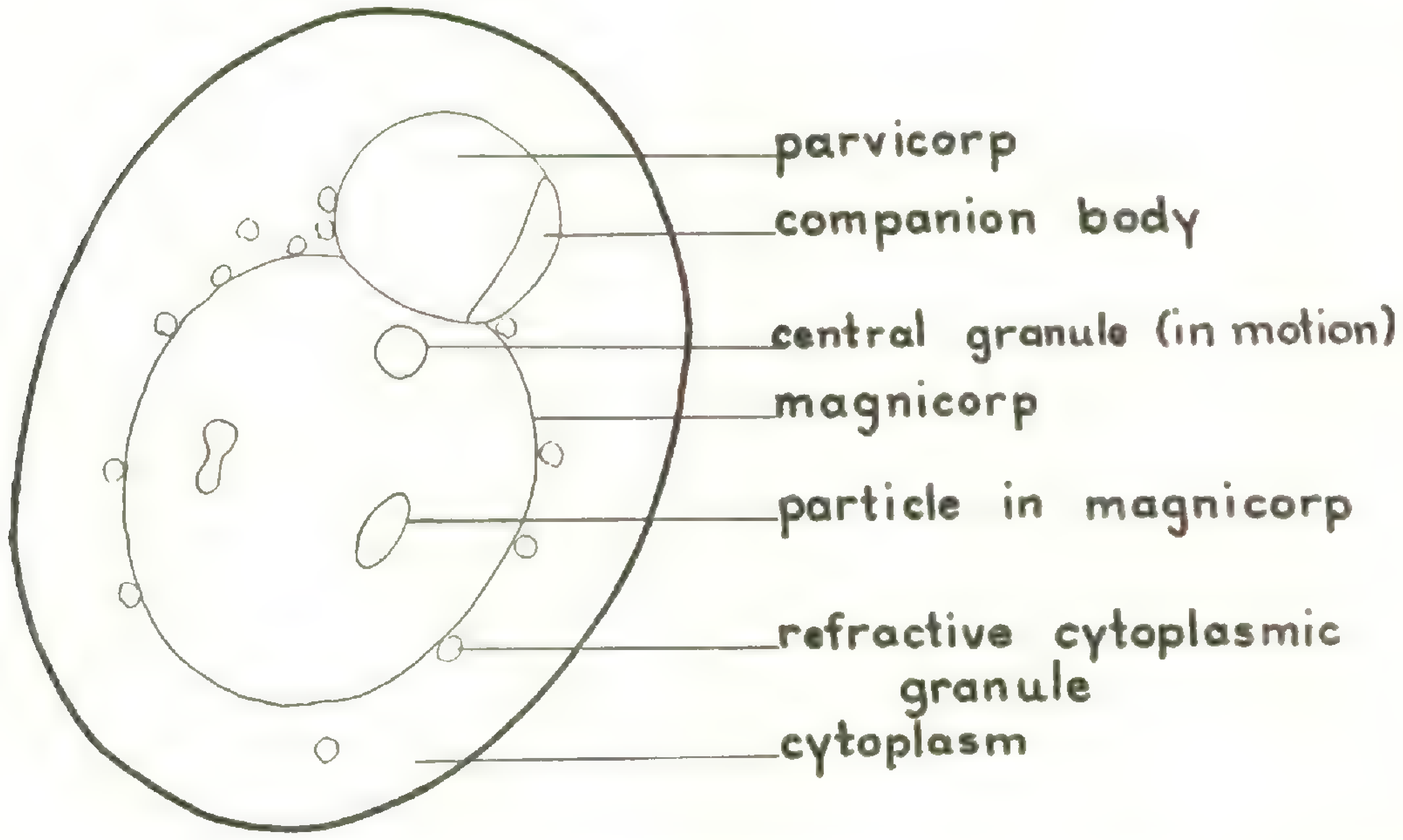
3. Methyl violet (Johansen, '40)	Navashin	1. Stain in 1% aqueous methyl violet 10 min. 2. Pass through: a. 0.5% picric acid in 70% alcohol 10 sec. b. 0.5% picric acid in 95% alcohol 10 sec. c. 95% alcohol (plus 4 drops NH_4OH per 100 cc.) 15 sec. d. 100% alcohol 10–15 sec. e. Clove oil 30–45 sec.	Results only fair; nothing added to those from other techniques.
4. Flemming's triple stain (Johansen, '40)	Navashin	1. Mordant 24 hrs. in 1% osmic acid in 2% chromic. 2. Stain in standard safranin solution 24 hrs. 3. Stain in 1% aqueous crystal violet 10–15 min. 4. Dip twice in 95% alcohol, 3 or 4 times in absolute. 5. Drop sat. sol. orange G in clove oil on c. g. 10 sec. 6. Wash in clove oil.	Results poor; added nothing to hematoxylin; could probably be improved by modification.
5. Heidenhain's hematoxylin (Johansen, '40; Lee, '37)	Mercuric chloride Navashin	1. Mordant in 4% ferric ammonium sulfate. Procedure a. 6–18 hrs. Procedure b. 1 hr. 2. Stain in 0.5% hematoxylin. a. 6–8 hrs. or overnight. b. 2–3 hrs. 3. Destain in sat. aqueous picric acid (Tuan, '30).	Shorter mordanting, staining, and destaining gave different picture from long. Cytoplasm tends to stain.
6. Brazilin	Same as Heidenhain's hematoxylin	1. Mordant 6 hrs. in 1% ferric ammonium sulfate in 70% alcohol. 2. Stain 6 hrs. in 0.5% Brazilin in 70% alcohol. 3. Destain in sat. picric in 70% alcohol.	Results similar to Heidenhain's hematoxylin.
7. Methylene blue-eosin (Badian, '37)	Picric acid Navashin Mercuric chloride	1. Overstain in 1% aqueous methylene blue 24–48 hrs. 2. Differentiate very slowly with dilute eosin (0.5% or less).	Results uncertain. Tends to lose stain in alcohol.
8. Aceto-, lacto-, and propionic carmine, orcein, Bismark brown	Alcohol-acetic acid. Also various mordants and pretreatments were used without success.	All combinations of the acids and stains in various concentrations were tried—heated and unheated, fresh and after standing. No permanent slides prepared.	Generally unsatisfactory. Aceto-orcein and propionic carmine usually some better than other combinations.

*All preparations were run up through alcohol series into xylol and mounted in balsam unless otherwise stated. Usual washing or rinsing steps not listed.

Observations

INTRODUCTION AND TERMINOLOGY

As mentioned in the Introduction there is as yet no general agreement among yeast cytologists even as to fundamentals. The body most frequently referred to as the nucleus (Guilliermond, '10, '20; Badian, '37; Beams, Zell, and Sulkin, '40) is called the centriole by another school (Lindegren, '45) and the nucleolus by a third (Wager and Peniston, '10). In the following observations new terms which are purely descriptive and have no previous connotation have accordingly been chosen in order to present a picture of results, independent of interpretations of nuclear organization in yeast. The term "parvicorp" (small body) will be used (text-fig. 1) to indicate that part of the yeast cell frequently designated as the



Text-fig. 1. Diagram of the yeast cell with parts labeled according to the terminology used in this paper.

nucleus. The term "magnicorp" (large body) will be used to designate the part usually called the vacuole, but also named the nucleus (Janssens and Leblanc, '98) and the nuclear vacuole (Wager and Peniston, '10; Lindegren, '45). A diagrammatic representation of these parts is shown in text-fig. 1.

Descriptions of budding material precede those of sporulating material. The results for each technique are given separately and in the order listed in Table III. The drawings on the plates follow the observations of the stained slides as closely as possible. All observations were made with a binocular microscope equipped with a 90 x apochromatic objective and 15 x compensating oculars.

SACCHAROMYCES CEREVISIAE

Studies of Budding Cultures

Feulgen Technique.—In all cells except small buds the parvicorp is at least faintly Feulgen positive (pl. 10). However, not all of the parvicorps exhibit the same color depth; a few are small and stain much more strongly than the larger ones. In some cells the parvicorp is evenly colored throughout, in others there is apparent variation in color intensity (pl. 10, figs. 4, 5, 11, 13). The buds often lack the parvicorp, but in that case it is frequently dividing in the mother cell or has finished its division or may not have started to divide, in which event it is commonly larger than usual (pl. 10, figs. 1–15). The division may be completed in the mother cell and the parvicorp then pass into the bud, but in many strains it more often appears to divide directly into the bud. In actively growing cultures the parvicorp is usually located proximal to the small bud and divides directly into it (Lindegren, '45). Where the budding is not quite so rapid the Feulgen positive body may be located between two parts of the magnicorp or even opposite the bud. After the buds acquire parvicorps the latter usually assume a distal position in mother and daughter cells (pl. 10, fig. 16). The parvicorp may vary in shape from round to oval, may be crescent-shaped, irregular in outline, or divided into two bodies, as noted earlier by Margolena ('32), Winge ('35), Badian ('37), and others. These bodies have often been interpreted as chromosomes (Table VI). Conventional mitotic figures were not seen in the dividing Feulgen-stained bodies of *Saccharomyces cerevisiae.* The Feulgen stain is faint and the parvicorp small, so that details are somewhat speculative.

The magnicorp, which was unstained but generally quite clear in outline, showed no Feulgen positive material with the procedure used. A discussion of the magnicorp will be deferred to the sections on methylene blue-eosin and Heidenhain's hematoxylin in which its structure is more readily observed. However, it might be mentioned here that the parvicorp almost universally lies in contact with the magnicorp.

Robinow's Giemsa Technique.—The use of this technique was suggested by La Cour (personal communication) after a number of others were found inadequate. The Robinow Giemsa bacterial stain ('42; Dubos, '45, with appendix by Robinow) was used with the following minor modifications. Osmic acid was slightly less satisfactory than mercuric chloride or iodine-formol-acetic acid as a fixation. Samples of stain were obtained from three sources and were found to vary somewhat in their staining ability. Destaining was not always even. Insufficiently destained and over-destained cells sometimes occurred on the same slide probably due to inadequate pH control. Difficulty with fading was overcome by controlling the pH of the various solutions, especially the balsam which was neutralized with sodium bicarbonate following the directions in Lee (9th edition, '28) and by storing the finished slides in darkness. The better slides produced by this method were the most satisfactory for observation of the parvicorp. However, good results were obtained only with the correct balance of all variables.

Giemsa stains the parvicorp in much the same manner as the Feulgen reaction but gives a much deeper color that shows more internal differentiation and greater contrast with the cytoplasm. Because of this sharpness of contrast the irregularity of the outline of many of the parvicorps is much more apparent than with Feulgen. Although many of the cells show parvicorps with relatively regular outlines more of those with irregular outlines are illustrated in pl. 11 in order to indicate the kind and degree of variation observed. The difference in color intensity within the stained bodies was often quite marked, resembling somewhat the chromocenters of higher plants. One or two small extrusions or appendages were often found. In older agar slant cultures, apparently aberrant divisions of the parvicorps without consequent division of the cell seemed to occur, giving such forms as shown in pl. 13, figs. 92, 93, 95–97. Haploid cells and their parvicorps were smaller than diploid, but measurements of the parvicorps were not attempted because their size variation in different stages of cell division made exact comparisons of doubtful value. Division of the parvicorp appeared much the same as with the Feulgen technique. A few of the parvicorps exhibited the bipartite structure noted in the preceding technique but the phenomenon seemed less in evidence, especially in the haploids.

The magnicorp was generally not visible with this technique, but when it was its relation with the parvicorp was usually clear and unquestionable. In these cells it lay in direct contact with the parvicorp as described above (pl. 11, figs. 30, 40, 42, 46). In a few cases various other relationships between these two bodies were observed, and several of these are illustrated (pl. 11, figs. 45, 47; pl. 13, figs. 96, 97). In these exceptional cells, however, the definition of the two bodies was somewhat obscure.

Methyl Violet and Flemming's Triple Stain.—Johansen's methyl violet staining method was used without appreciable change. Methods developed by Smith ('34), Newton (Johansen, '40), and Hancock ('42) did not give good results but would probably prove satisfactory if time were taken to modify them.

The parvicorp generally stained in much the same manner as with Feulgen (pl. 12, figs. 48–60), but sometimes only part of it retained the stain, the slides thus resembling certain Heidenhain's hematoxylin slides (pl. 12, figs. 51, 53, 56). The magnicorp showed no particles or stained structures. Similar but less certain results were obtained with Flemming's triple stain (pl. 12, figs. 61, 62). As these staining procedures provided little additional information to that acquired from other techniques and as they were more troublesome to carry out, they were not used extensively.

Heidenhain's Hematoxylin and Brazilin.—After long mordanting and staining with Heidenhain's hematoxylin (5a, Table III) the entire parvicorp remained black (pl. 13, figs. 72–81). With the short staining procedure (5b, Table III) usually a black area designated here as the companion body (text-fig. 1) stained at one place and the remainder of the parvicorp was lighter than the surrounding cyto-

plasm (pl. 13, figs. 82–89). This differentiation resembled that shown in Wager and Peniston's figures of the "chromatin patch" except that the "peripheral layer of chromatin" was not generally apparent, nor did the companion body exhibit as great a diversity of shape as the authors illustrate (Wager and Peniston, '10, pl. 16, figs. 53–80). This same phenomenon shows to some extent with Brazilin and methyl violet techniques but is not apparent with any of the others that were used, although identical fixations were frequently employed.

In either budding or resting cells this companion body was often double and occurred in any one of several positions, probably due to both the orientation under the microscope and the condition and stage of development of the cell. Division of the companion body at mitosis is difficult to follow even in slides of actively budding cultures. It seems to elongate greatly and divide by thinning in the center (pl. 13, figs. 83, 89). In the non-budding cell the parvicorp appears to have a very regular outline; in the budding cell it is not distinct as the contrast between cytoplasm and parvicorp is not great. With the longer staining procedure results are similar to those of the Feulgen and Giemsa techniques, but no differentiation within the parvicorp is visible, the boundary is usually regular, and no extrusions or appendages are apparent. The parvicorp may destain in various unusual patterns, especially in old or poorly nourished cells, and give rise to figures such as pl. 13, fig. 76, which, although they may resemble conventional mitotic stages, probably do not represent a division stage at all. Because the cytoplasm sometimes destains irregularly, results are difficult to interpret. Therefore, in spite of the recent work of Subramaniam and Ranganathan ('45), the author does not consider this technique one of the most satisfactory for the study of yeast cytology, certainly not the technique to use as the sole basis of interpretation.

The magnicorp appears clear and optically empty in budding material. However, if it is shrunken or distorted in fixation, as sometimes happens, the folds tend to retain the stain and give the appearance of strands passing over the surface (pl. 13, fig. 73). In well-expanded and preserved magnicorps this phenomenon was not apparent. Wager and Peniston reported a "chromatin network" over the surface of the magnicorp as a regular cell component, possibly because they regularly dried their preparations after fixation. There are times when denser strands of cytoplasm seem to radiate from the parvicorp and may or may not extend out over the magnicorp depending upon the relative positions of the two cell bodies (pl. 13, figs. 77, 78). The early entrance of the magnicorp into the bud is especially apparent with this stain when it follows mercuric chloride fixation. Subramaniam and Ranganathan have used a Carnoy fixing solution which usually leaves the magnicorp invisible and the relative positions of cell components uncertain.

Brazilin gives results similar to Heidenhain's hematoxylin, staining either the entire parvicorp or only the companion body depending upon the length of staining and destaining (pl. 12, figs. 63–71). With the shorter procedure the parvi-

corp sometimes shows shadowy material extending from the companion body (pl. 12, fig. 65).

Methylene Blue-Eosin Technique.—The Giemsa-eosin technique of Badian ('37) was modified by substituting methylene blue for Giemsa. It can be said of it also: "L'application de cette méthode de différenciation aux Levures n'est pas toujours facile—" [Badian, '37, p. 64]. Staining and differentiation of the cells in bulk in a centrifuge tube were more easily controlled than on the cover glasses although both methods were used.

Certain particles or granules in the yeast cell stained a brilliant blue-red when the differentiation was carried just far enough; further differentiation in eosin left the entire cell a faint, even pink. The position, number, and size of these particles apparently depended in part on physiological conditions, in part on fixation. In a 48-hour unshaken broth culture the stained bodies, if present, were found within the magnicorp (pl. 14, figs. 98–107); in a similar culture that was shaken and crowded colored particles appeared to lie at the periphery of the magnicorp or occasionally in the cytoplasm (pl. 14, figs. 109–112). In the unshaken culture, the parvicorp stained faint pink in the blue cytoplasm and was clearly visible in 98 per cent of the cells, but little or no differentiation was noted. The outline was quite regular and clear. In this same culture approximately 85 per cent of the yeast cells contained no particles at all in the magnicorp; the rest contained one or more of various sizes and shapes (Table IV). In the shaken culture the

TABLE IV

NUMBER OF PARTICLES PER CELL IN THE MAGNICORP OF YEAST CELLS STAINED WITH METHYLENE BLUE-EOSIN TECHNIQUE (100 CELLS SELECTED AT RANDOM).

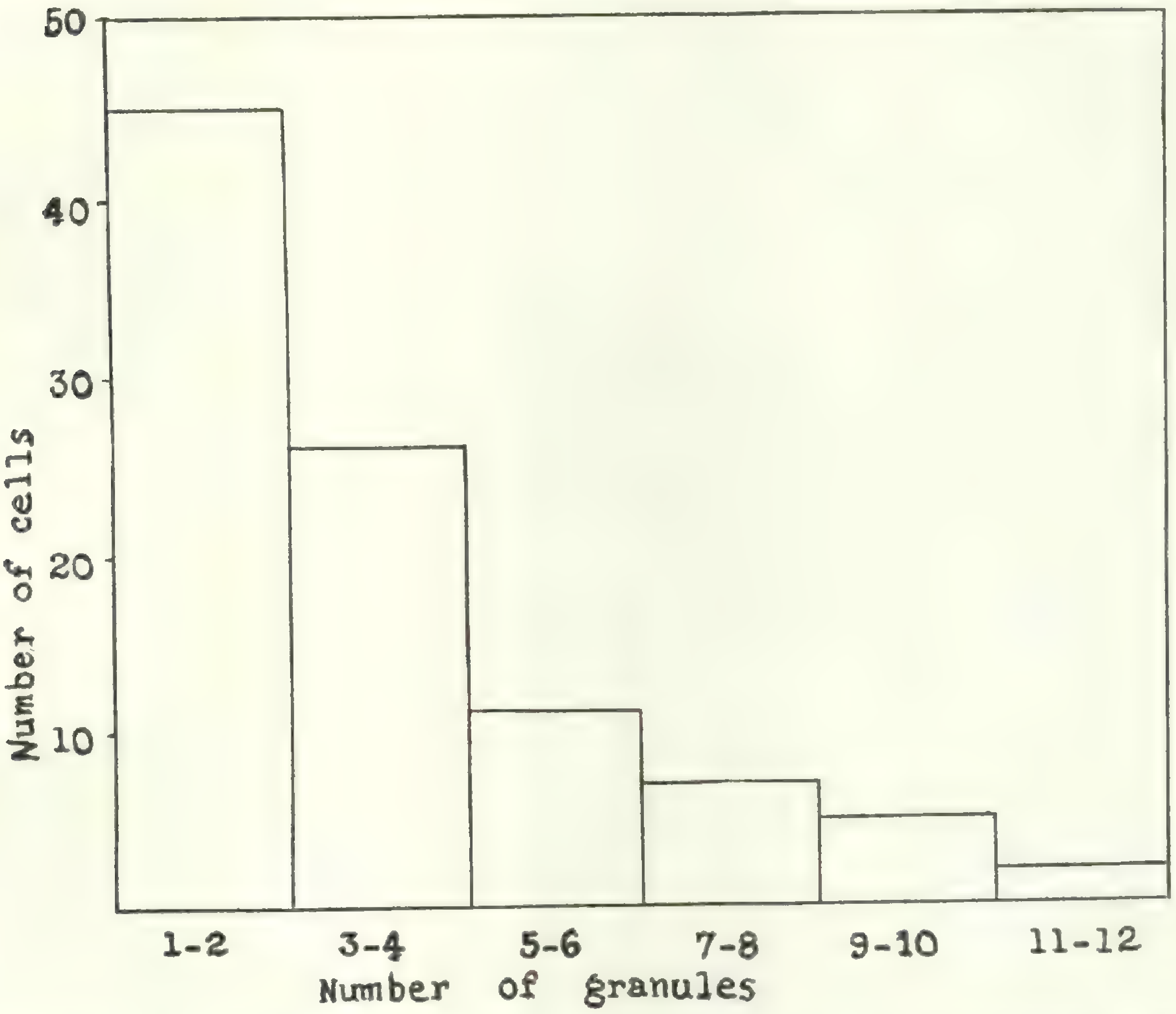
Number of particles per cell	0	1	2	3	4	5	6	7	8	9	10 or more
Number of cells	85	4	2	2	2	—	1	1	—	1	2

particles were exceedingly numerous and were present in most cells where differentiation was not carried too far. The parvicorp was not visible in these cells.

Granule number per cell was counted in 100 granule-containing cells (15 per cent of the total cell number). The results are diagrammed in text-fig. 2. Most of the cells in this culture contained few particles which at times appeared irregular in outline as if they were possibly aggregates, but the total amount of material in the magnicorps was not uniform.

In a few instances the particles appeared paired (Table V). The pairs of granules were similar in staining reaction, size, and shape. At times they occurred as separate particles; at times the two were joined in dumbbell ("diplokokken ähnlich", Henneberg, '16) or V-shaped masses with the two ends alike in shape and size. Rarely all of the particles of a cell appeared paired (pl. 14, fig. 107);

more often there were only one or two such pairs, the other particles not showing this condition. The number of pairs of granules was not constant. Due to the position and arrangement of granules in some cells it was not always possible to be certain whether or not they were paired. These are listed in Table V as "Possibly paired."



Text-fig. 2. Number of granules per cell in the magnicorps of 100 granule-containing cells.

TABLE V

PER CENT OF YEAST CELLS SHOWING PAIRING OF THE PARTICLES IN THE MAGNICORP WHEN STAINED WITH METHYLENE BLUE-EOSIN.

	% of granule-containing cells	% of total number of cells in culture
No apparent pairing	82.+	12.+
One or more pairs present	9.—	1.
Possibly paired	9.	1.+

Actively budding yeast from a yield test (4 hour 20 minute shaken culture) showed very faintly differentiated parvicorps and a few cells which contained as many as thirty to fifty stained particles. The latter were in or at the periphery of the magnicorp (pl. 14, fig. 108) and in several instances were passing into the bud. Due to the large number of somewhat similar granules in the cells pairing could not be determined.

Aceto-Carmine and Related Smear Techniques.—As mentioned in Table III, various concentrations and mixtures of acetic acid, lactic acid, and propionic acid were tried with the following dyes used singly and in combination: carmine, orcein, and Bismark brown. Results were generally unsatisfactory. Granular cytoplasmic material stained so deeply as to obscure the parvicorp in most cases and the magnicorp was generally shrunken and distorted. Various fixations beside acetic-alcohol and a number of other treatments and mordants suggested in the literature (Darlington and La Cour, '42) were tried with little success. Aceto-orcein and propionic carmine were somewhat more satisfactory than other solutions. Gentle heating helped bring out contrast, and the slides improved a little after standing for two to five days at room temperature. The cells which stained most clearly were those from the edge of giant colonies two to four weeks old, grown on nutrient agar in a moist chamber (pl. 14, figs. 113–119). Probably this is due to the relatively small amount of granular material in the cytoplasm of these cells (author's research, unpublished). The parvicorp may be rounded, or, more frequently, somewhat star-shaped, or may occasionally appear bipartite, especially in dividing cells. The magnicorp (if visible at all) is usually shrunken, distorted, and empty. Although much time was spent in trying to adapt this technique to yeast, it was finally abandoned as unsatisfactory.

Studies of Sporulating Cultures

Feulgen and Giemsa Techniques.—Because of the similarity of results with these techniques, they are considered together. In any sporulating culture only a few cells were in meiotic division at any one time, and the extremely small number found in certain stages would indicate that at least parts of the process are very rapid. Preceding spore formation, the parvicorp becomes approximately twice its normal diameter, appears filamentous, and resembles the prophase of the conventional meiotic division as closely as could be expected in anything as small and unique as a yeast cell (pl. 14, figs. 123–127; pl. 15, figs. 128–130, 141–144). This phase appears to be of long duration as it is quite common in slides of sporulating cultures. The next steps in the division are not too certain and probably proceed with great rapidity as few instances were found that could be definitely assigned to this phase in the many slides that were examined. Probably such stages as pl. 15, figs. 131, 145, 146, 149, 150 belong in this category. Very

rarely two parvicorps lying beside or above each other were found toward the center of the cell (pl. 15, fig. 151; pl. 16, figs. 173, 174). While this position might be the logical expectation, its extreme rarity leads one to believe that the second division normally follows the first so rapidly that the stage with two parvicorps may not actually become organized in most cells. The second division appeared to start near the center of the cell. Two elongate, slightly dumbbell-shaped masses were formed, the ends of which passed toward the periphery of the cell, usually toward opposite poles. A gradual thickening of the extremities of the masses occurred at the expense of the center (pl. 15, figs. 132–136; pl. 16, figs. 152–158). Such division figures were relatively common. Cells with elongate parvicorps which appeared bipartite or possibly four-partite were also relatively common in all sporulating material (pl. 15, figs. 147, 148). These may represent a stage which either follows the more diffuse early stage or might be the beginning of the second division. Instances of a single parvicorp at each pole of the cell were not positively ascertained; careful study of apparent examples usually showed that at least at one pole one body could be resolved above the other, and that the second division had actually taken place. When division is first completed, the parvicorps usually lie at the periphery of the cell close to the wall and the spore plasm lying between them is frequently more dense than the epiplasm[1] (pl. 16, fig. 160). The organization of the ascospores seems to occur in a manner similar to that of other Ascomycetes. Apparently the spore is delimited by being cut out by rays extending from the parvicorp. At times one or two of the ascospores develop more rapidly than the others. Ray-like strands of cytoplasm frequently extend out from the parvicorp in the fully formed ascospore. If only two or three ascospores develop, the other parvicorps can be observed lying free in the ascus (pl. 15, figs. 139, 140). Single spores with two or more parvicorps were not seen. Old agar slants of diploid cells, some sporulating, showed aberrant divisions in which the parvicorp apparently divided without subsequent cell division. In some of these cells the parvicorp was divided into separate particles (pl. 13, fig. 97).

Meiotic division of the magnicorp could not be followed in either technique. Although this body is generally visible in budding material stained with Feulgen, it was imperfectly visible, if at all, in sporulating cells (except in the fully developed ascospores where it again appeared empty).

Notes On Other Techniques.—Aceto-orcein was unsuccessful as a stain for the division figures of spore formation because of the deeply staining, granular cytoplasm. However, the formation of the ascospores was similar to that observed with Giemsa and in the fully developed ascospores an empty magnicorp was generally visible (pl. 17, figs. 193, 194).

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[1] In Ascomycetes, the cytoplasmic contents of the ascus not used in spore formation.

Methylene blue-eosin was not especially useful as a stain for sporulating material, nor did the conventional volutin reaction give an enlightening picture of the magnicorp and its particles in meiosis. With both techniques, if magnicorps were visible, stained particles in them were few (exceptionally there were many particles or none). No regular organization of magnicorp and its contents was ascertained.

Slides stained by the longer procedure for Heidenhain's hematoxylin (5a, Table III) or by Brazilin gave much the same results as Giemsa and Feulgen, but less distinct due to the retention of stain by the granular cytoplasm (pl. 16, figs. 165–175). If stained by the shorter method (5b, Table III), the results were so variable as to be uninterpretable and the companion body could not be followed. The magnicorp, though evident in budding and resting cells with these techniques, could not be followed in sporulating material.

Studies of Living and Supra-vitally Stained Cultures

Comparative studies on living cells of cultures were made whenever slides were prepared. In budding cells the parvicorp was only rarely visible in living cells, although its position could often be determined by a slight invagination of the magnicorp. The latter body could almost always be seen except in certain small, very dense cells where it was probably obscured by the highly refractive surrounding cytoplasm. It occurred usually as one body, occasionally as two, more rarely as several to many, depending on the age, nutrition, aeration, and other cultural conditions of the cells. At times one to several particles could be seen moving in the magnicorp, and occasionally these appeared to be paired.

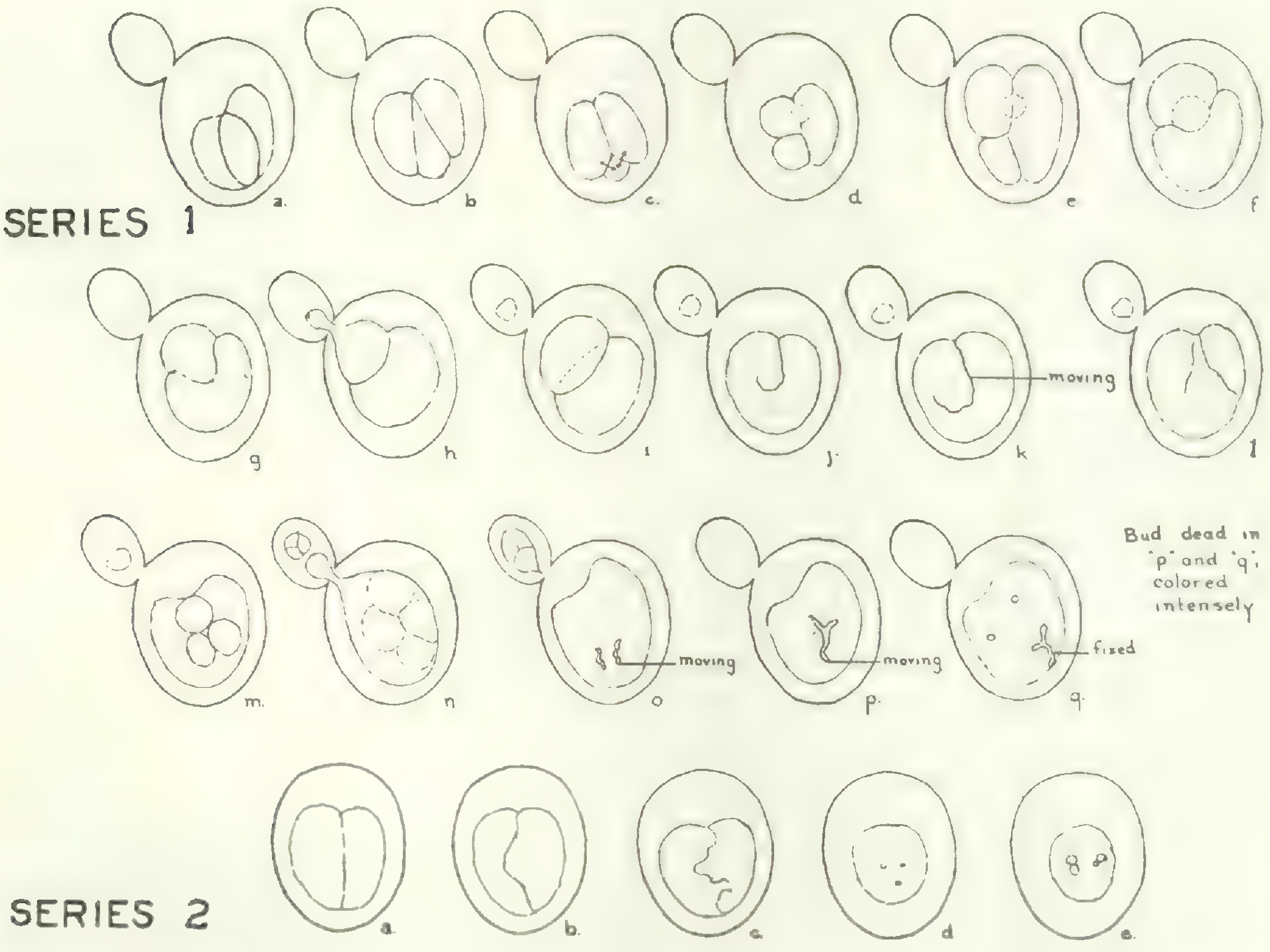
The cytoplasm of many living cells from presporulating cultures was so highly granular that all other structures were obscured. It was from these that spores developed. Although a number of methods of observing the formation of spores in living cells was tried, only the one described below was found satisfactory. Nothing externally visible occurred in the living cell the first twelve to sixteen hours on the gypsum slant, the variation in time depending upon the culture, temperature, presporulating medium, etc. After the culture had been on the gypsum slant for twelve hours samples were examined at half-hour intervals. The movements of yeast cells are sufficiently rapid that for accurate continued observation it was found imperative to restrain them as much as possible. The following technique prevented excessive motion, yet kept the yeast in viable condition under the microscope for five to seven hours. A tiny frayed-out fragment of lens paper was placed on a No. 1 cover glass and both were dipped in alcohol and flamed. With a little practice the lens paper fibers spread flat and evenly and are not charred. A drop of sterile water acidified to about pH 4 with acetic acid was placed on the lens paper and a few cells from the gypsum slant were added with a needle. The cover glass was placed cell-side down over a concave (drop) slide to provide an air chamber and the edges were sealed with wax. The

yeast cells gathered along the lens paper fibers, and Brownian movement was thus greatly reduced. Where the cells were not crowded, an observation every fifteen to twenty minutes kept a given cell or group of cells in view. Thus individual cells could be watched from the first sign of spore delimitation to complete spore formation, a process that took three to five hours at room temperature under these conditions. In acidified water with no air space, in agar, or in oil, sporulation also occurred but only sporadically and after one to five days.

In living cells the spores appeared to be delimited in the same manner as described for prepared slides. Several instances were observed in which the four spores were formed from the protoplasm at one end of a large cell. The other end was occupied by a body which resembled the magnicorps of other cells on the slide although no proof of its actual identity therewith was ascertained. A cell of this kind from a Giemsa-stained slide is illustrated in pl. 17, fig. 195. Generally the magnicorp was not visible in the living cells during the process of sporulation.

When iodine was applied to budding cells, it had the effect of temporarily bringing the parvicorp into "relief" and of emphasizing the particles in the magnicorp, often revealing them in rapid Brownian motion.

Toluidine blue was also applied to budding cultures. This dye at times caused



Text-fig. 3. Series of sketches of two cells under the influence of toluidine blue solution.

very striking reactions in the magnicorp, but the parvicorp was never visible. Changes in the magnicorp were especially apparent with continuous observation of a single cell. Text-fig. 3, Series 1, shows sketches of the changes in the magnicorp of a budding cell observed continuously for forty-five minutes. In "h" and "n" the magnicorp was seen to burst rapidly out into the bud. Series 2 shows a similar non-budding cell. Granules of various sizes often stain in the magnicorp with this procedure; occasionally also parts of the cytoplasm stain, and the cells finally die and become deeply colored throughout.

WILD YEASTS

Studies of Budding Cultures.—Several yeasts were collected in the wild and a few cytological observations were made on two of them. A brief account is given here of these fragmentary observations since they are rather suggestive when compared with the results with *Saccharomyces cerevisiae.* Had these yeasts been obtained earlier in the progress of the investigation more detailed observations on them would have been made.

The yeast represented in pl. 17 is one of a number which was isolated from wild fruit gathered late in the fall of 1945 at the Missouri Botanical Garden Arboretum near Gray Summit, Missouri. While it has not been positively identified, since it has not yet been induced to sporulate, it can be placed tentatively in the Fungi Imperfecti, possibly in *Syringospora* or *Blastodendrion* or a closely related genus and probably represents an undescribed species. It is an especially large-celled yeast that produces from two to twelve easily detached buds in bipolar position when growing actively on nutrient agar. A few Giemsa and Feulgen slides were made in order to study its cell organization when producing the higher number of buds.

From one to twelve parvicorps (Feulgen and Giemsa positive) were found per cell, the number depending on their size and the amount of budding. Commonly there were more parvicorps than buds. As was noted in the microscopic study of the living cells, the buds were very delicately attached and some of them may have been broken off in handling. Probably also the division precedes the bud formation in this species. While no attempt was made to check this fact, the very large number of parvicorps in certain cells (pl. 17, figs. 176, 177, 186) would suggest such a possibility. However, small, detached, immature buds without parvicorps were frequently observed. When numerous parvicorps were present they were often of two distinct sizes, the smaller ones staining more intensely. In contrast to *Saccharomyces cerevisiae* the parvicorp is often separated into particulate units at division (pl. 17, figs. 178, 180, 183, 187, 189). When several parvicorps were present all seemed to divide synchronously, as cells were noted with two, four, or eight in division at the same time. Dividing and non-dividing parvicorps were not observed in the same cell. Wherever the magnicorp

was visible it was empty, but when many parvicorps were present they sometimes seemed to fill the whole cell.

Another of the wild yeasts from the same collection (a *Cryptococcus*?) should be mentioned because under certain cultural conditions (usually when several days to a week old) moving particles in the magnicorp were the rule rather than the exception and many of the particles seemed paired in dumbbell fashion. In some sections of one particular slide almost half the magnicorps had two equal particles, closely paired, each pair moving as a unit. Under other conditions, especially in young or older cultures, this phenomenon was not apparent.

Discussion

The very nature of vegetative reproduction in budding yeasts would lead one to expect their mitoses and nuclear organization to exhibit certain exceptional phenomena. As there is nothing quite comparable to this budding process in the plant or animal kingdom, interpretation of nuclear organization should take into account as inclusive a picture of all cell components as possible. Both parvicorp and magnicorp seem to be associated with vegetative cell division and a complete interpretation must take cognizance of both. From genetics there is now exact indirect evidence on the organization of the yeast cell. The excellent work of Lindegren, Spiegelman, and Lindegren ('44) and of Winge ('39, '44) has demonstrated the regular Mendelian segregation of characters at meiosis. Diploid strains, reproducing only vegetatively, are stable and retain their cultural characteristics as would be expected; haploid cultures exhibit a far greater mutation rate. This is easily observed in giant colony structures where haploids show frequent sector mutations which are generally lacking in the more stable diploids. Therefore in spite of its small size and peculiar vegetative reproduction yeast cannot be greatly different in its fundamental organization from other organisms although in various superficial details of mitosis and meiosis one may confidently expect considerable modification.

Similar superficial modifications of mitosis and meiosis have been reported for a variety of tissues and organisms. In the pollen tube of the spermatophytes, when mitosis of the generative cell must occur within narrow confines, it is often somewhat atypical; the metaphase plate may be greatly elongated and there may be no visible achromatic figure (Trankowski, '30). In the Protista, Belar ('26, '28) has shown that fundamentally regular but superficially atypical nuclear organization is not uncommon. As mentioned before, several conflicting interpretations of nuclear organization of yeast have been presented in the past and there is to date no general agreement. Table VI presents in tabular form the varying interpretations by previous authors of the disputed entities of the yeast cell.

In the light of the work of Mazia and Jaeger ('39), Caspersson and Schultz ('38), Caspersson ('39a, '39b, '40), Mirsky ('43), Mirsky and Pollister ('43a, '43b), Pollister and Mirsky ('43, '44), Greenstein ('44), Davidson and Way-

mouth ('44), and many others, the Feulgen positive staining of the parvicorp would seem indicative of its nuclear nature. The constancy of the parvicorp as a cell component and its non-homogeneous character when stained with Giemsa supports this interpretation. Opponents to this view point out that the division of the parvicorp appears to be amitotic. Since division is intra-nuclear in many fungi, this fact plus the very small size of the parvicorp make resolution of individual chromosomes difficult with the ordinary microscope. In the wild yeast described above particulate units were observed at certain division stages in both Feulgen and Giemsa slides. In the early stages of meiotic division in S. *cerevisiae* the parvicorp becomes enlarged and appears filamentous, resembling the usual early meiotic prophase nucleus, but its small size makes accurate resolution difficult. As is true of many nuclei, the parvicorp stains more intensely with Feulgen at some stages than it does at others. It is visible in all stages of division in all cells stained with Feulgen and Giemsa and with Heidenhain's hematoxylin and Brazilin if destaining is not carried too far, but is rarely visible in the living cells. In ultra-violet photographs (Caspersson and Brandt, '41; Brandt, '41) the two types of nucleic acid are indistinguishable. These authors state that this technique does not generally differentiate the nucleus in yeast. In the very actively budding cells, however, the parvicorps appear in the photographs as diffuse, somewhat lighter areas in the deeply absorbing cytoplasm, sometimes seeming not much more absorbent than the magnicorp which they state contains very little nucleic acid.

The magnicorp enters the bud before the parvicorp and is probably of importance in bud initiation as suggested by Lindegren ('45). If particles are visible within the magnicorp they also enter the bud, and at times they seem to be paired or assume form or position difficult to explain as "reserve stuff." These phenomena plus the apparent amitosis of the parvicorp have led to the interpretation (Janssens and Leblanc, '98; Wager and Peniston, '10; Lindegren, '45) of the magnicorp and its contents as the nuclear vacuole and chromatin respectively. Although the magnicorp and its contents are Feulgen negative at all stages of growth and division, Lindegren ('45) has pointed out that the desoxyribosenucleoprotein nature (Feulgen positive) of nuclei of higher organisms does not necessarily indicate its universality in the chromatin of simpler organisms. However, if the magnicorp is interpreted as the nuclear vacuole and the parvicorp as the centriole, the latter is not usually Feulgen positive. If visible, the particles in the magnicorp vary greatly as to size, shape, and number: (a) with physiological conditions—age, nutrition, aeration, etc.; (b) with the strain; and (c) with fixation. Their chemical composition is not known with certainty, but common nuclear fixing solutions are not generally effective, and special fixation, as, for example, with formaldehyde, must usually be employed. As pointed out earlier, the magnicorp is usually a single body, but often seems to occur as two bodies, one at either end of the parvicorp. In old or starved cultures it may appear to be divided into a number of parts (Brandt, '41), in which case the particles may occur in any or

all the parts of the magnicorp. Budding cells very commonly show no stained particles with the techniques employed. The number of particles counted in cells of different cultures stained with methylene blue-eosin varied from none in most cells to as high as fifty. Van Herwerden ('18) found the number of particles related to phosphorus content of the nutrient medium. With dark field illumination the rate of Brownian motion of particles in the magnicorp and in the surrounding medium is similar, indicating a very low viscosity. On the contrary, the lack of Brownian motion in the vicinity of the parvicorp and its tendency to bulge into the magnicorp would indicate a higher viscosity for the former. The pressure changes of the magnicorp with toluidine blue are likewise indicative of low viscosity, a character more usually associated with vacuolar behavior than with nuclear "sap." Difficulty in following any organization of the magnicorp through meiotic division in this investigation (also by Janssens and Leblanc, '98; and Wager and Peniston, '10) points strongly away from a nuclear interpretation but improved techniques may alter this. However, the presence of the magnicorp in the fully developed spore indicates its importance as a cell entity.

Various chromosome numbers in various parts of the cell have been suggested: two—both haploid and diploid—by Badian ('38); approximately eight—diploid —by Kater ('27) in the parvicorp; and twelve by Lindegren ('45) in the magnicorp. Although a number of investigators have noted the division of the parvicorp into two bodies at times and have called these chromosomes, present genetic evidence (Lindegren, personal communication, unpublished) does not point to this chromosome number, and cytological evidence is as yet uncertain. Undoubtedly the parvicorp is divided into two bodies at times, but if these are chromosomes they are large enough that they should be seen occasionally in metaphase or anaphase configuration. If the parvicorp is nuclear, further refinement of technique is necessary to be certain of chromosome number. If the magnicorp is nuclear, the variability of the number of particulate units is suspiciously great. However, because of the small size of the yeast cell and its lability under various cultural conditions, this objection has less force than it would have in other material. As mentioned previously, the parvicorp of the wild yeast described above appeared to separate into particulate units during mitosis but these were too crowded together for the number to be certain.

At least four parts of the yeast cell have been interpreted as the nucleolus (Table VI). Wager and Peniston ('10) considered the parvicorp as the nucleolus with the chromatin network extending from it over the magnicorp. This places the "nucleolus" entirely outside of the "nucleus" as they interpreted it, certainly an unusual position for it. Brandt ('41) and Caspersson and Brandt ('41) consider the ribonucleic acid-containing granules scattered throughout the cytoplasm (designated as "volutin" by them) the equivalent of the heterochromatin and nucleolus of higher organisms. Janssens and Leblanc ('98) sometimes called the central granule of the magnicorp the nucleolus, and Guilliermond ('20) and

TABLE VI

INTERPRETATIONS OF DISPUTED ENTITIES OF CELL ORGANIZATION BY VARIOUS INVESTIGATORS OF YEAST CYTOLOGY

Cell entity	Janssens and Leblanc, '98	Guilliermond, '03, '10, '20	Kohl, '08	Wager and Peniston, '10	Henneberg, '16	Kater, '27	Winge and Laustsen, '35, '37	Badian, '37	Beams et al., '39	Brandt, '41	Lindegren, '45	Subramaniam and Ranganathan, '45, '46a, '46b
Parvicorp	Part of nucleus (sometimes nucleolus?)	Nucleus containing nucleolus	Nucleus, possibly containing nucleolus	Nucleolus	Nucleus	Nucleus containing nucleolus (approx. 8 chromosomes)	Nucleus—probably 2 chromosomes	Nucleus—2 chromosomes in both haploid and diploid	Nucleus	Euchromatin of nucleus (2 chromosome equivalents)	Centriole (bipartite)	Nucleus—normally of 2 equal chromosomes
Magnicorp	Part of nucleus	Vacuole	Vacuole	Nuclear vacuole	Vacuole	Vacuole	Vacuole	Vacuole	Vacuole	Vacuole	Nuclear vacuole	——
Particles in magnicorp (may or may not be in motion)	?	Metachromatin (volutin)	Volutin	Chromatin network	Volutin	*No* particles in magnicorp	——	Volutin	——	Metachromatic granules	6 pairs of chromosomes	——

TABLE VI (continued)

Refractive, non-fatty cytoplasmic granules	?	Basophile granules	Volutin? and "Eiweiss-krystalle"	Volutin	Volutin?	Meta-chromatic granules (often a reticulum extending out into cytoplasm from parvicorp)	—	Volutin	—	Volutin—equivalent of hetero-chromatin and nucleolus of higher organisms also meta-chromatin	—	—
Companion body	?	—	—	Chromatin patch	—	—	—	—	—	—	Mentioned	—
Central granule of magni-corp (in motion)	Nucleolus?	—	—	Central volutin granule	—	—	—	—	—	—	Possibly "balled up" chromo-somes	—

Kater ('27) thus designated the deeper-staining body or bodies in the parvicorp. At times one or more such bodies are visible in the Giemsa-stained slides, but whether these are sufficiently consistent to be considered the nucleoli is questionable.

Whether or not a membrane surrounds the parvicorp has been a question of debate. Its presence is indicated by the regularity of outline of the parvicorp after certain treatments, for example, with methylene blue-eosin and with Heidenhain's hematoxylin (short procedure; pl. 13, figs. 82–88; pl. 14, figs. 98–108). It is true that the parvicorps in Giemsa and Feulgen slides often show an irregular outline. Acid hydrolysis has been carried out with both of these, and although Bauer ('32) has demonstrated that this treatment does not alter the structure of the desoxyribosenucleoprotein-containing material, there is no reason to believe that a membrane, if present, would stain. Studies of the magnicorp indicate that there is a membrane separating it from the cytoplasm. At times it appears to be a double membrane for occasionally after fixation the magnicorp seems to shrink away from the cytoplasm in places as if both possessed membranes.

If the nucleo/cytoplasmic ratio is considered, the parvicorp alone gives a ratio which is possibly slightly low, the combined parvicorp and magnicorp an exceptionally high one.

It is thus apparent that after one hundred years of cytological work, the organization of the yeast nucleus is still a matter for debate among authorities, even as to the most elementary points. Direct observation, uncorrelated with other techniques, must probably continue to be relatively unproductive with objects as microscopically refractory as the yeast cell. However, direct cytological observation in combination with other techniques presents a more encouraging picture. Among the most promising of these developments are the following:

(1) Additional genetic studies such as those of Lindegren and Winge. Eventually they should demonstrate the chromosome numbers, their comparative size, and even chiasma frequencies and positions.

(2) Further biochemical studies along the lines of those of Mirsky and Pollister on higher organisms, combined with studies of the effects of enzymatic action on the several cell entities. A more complete knowledge of the chemical nature of the particles in the magnicorp and of the refractive granules in the cytoplasm should aid in an understanding of their role in cell organization and metabolism.

(3) Comparative cytological studies of wild yeasts. Species with larger cells or clearer cytoplasm should reveal more details of cell structure. Wild yeasts which reproduce by budding but which also develop true or pseudo-mycelia are frequently encountered. A cytological study of these species would relate the recognized entities of the yeast cell to the more usual mycelial type of growth.

(4) Additional investigations with ultra-violet and "phase-difference" microscopes and the study of thin sections with the electron microscope.

(5) Further refinements of cytological techniques. A method of removing, softening, or breaking the firm cell wall (possibly by enzymatic digestion, chem-

ical maceration, or pressure) which would permit spreading of the cell contents without excessive distortion should make further details of the parvi- and magnicorp resolvable. A study of the effects of cold treatment on different stages of spore formation may make it possible to obtain many more cells at one time in certain phases of meiosis. New techniques, as well as improvements in present fixation and staining procedures, should provide additional information for correlation with other methods.

Summary

1. A review of the literature on the cytology of yeasts showed great confusion in:

(1) use of terms,

(2) interpretation of nuclear structure.

(This is demonstrated in tabular form in Table VI.) An attempt was made to apply systematically a whole battery of techniques to both sporulating and budding material of yeast *(S. cerevisiae)*.

2. All of the techniques tried out are listed and described. Those used extensively are discussed in detail.

3. A descriptive terminology for the major cell entities (parvicorp, magnicorp, companion body, text-fig. 1, p. 254) is adopted in order to permit presentation of observations unbiased by earlier interpretations.

4. Fragmentary observations on two wild yeasts are included for comparison (pp. 264–265).

5. The "parvicorp" is a Feulgen positive, non-homogeneous, constant cell entity. Vegetative division does not appear to be typically mitotic in *S. cerevisiae*, but at least the prophase of meiosis resembles conventional configurations. A large-celled wild yeast showed particulate units of the parvicorp at mitosis.

6. The "magnicorp" (vacuole or nuclear vacuole of most authors) is Feulgen negative. It is almost universally present in budding material and enters the bud before the parvicorp, but is generally invisible in presporulating and sporulating material. Granules of the magnicorp are lacking in most cells with the techniques employed, but, when present, occasionally appear paired.

7. Relationships of these observations to the several interpretations of nuclear organization are discussed briefly (pp. 265–271), and suggestions are made as to possible future advances in this field.

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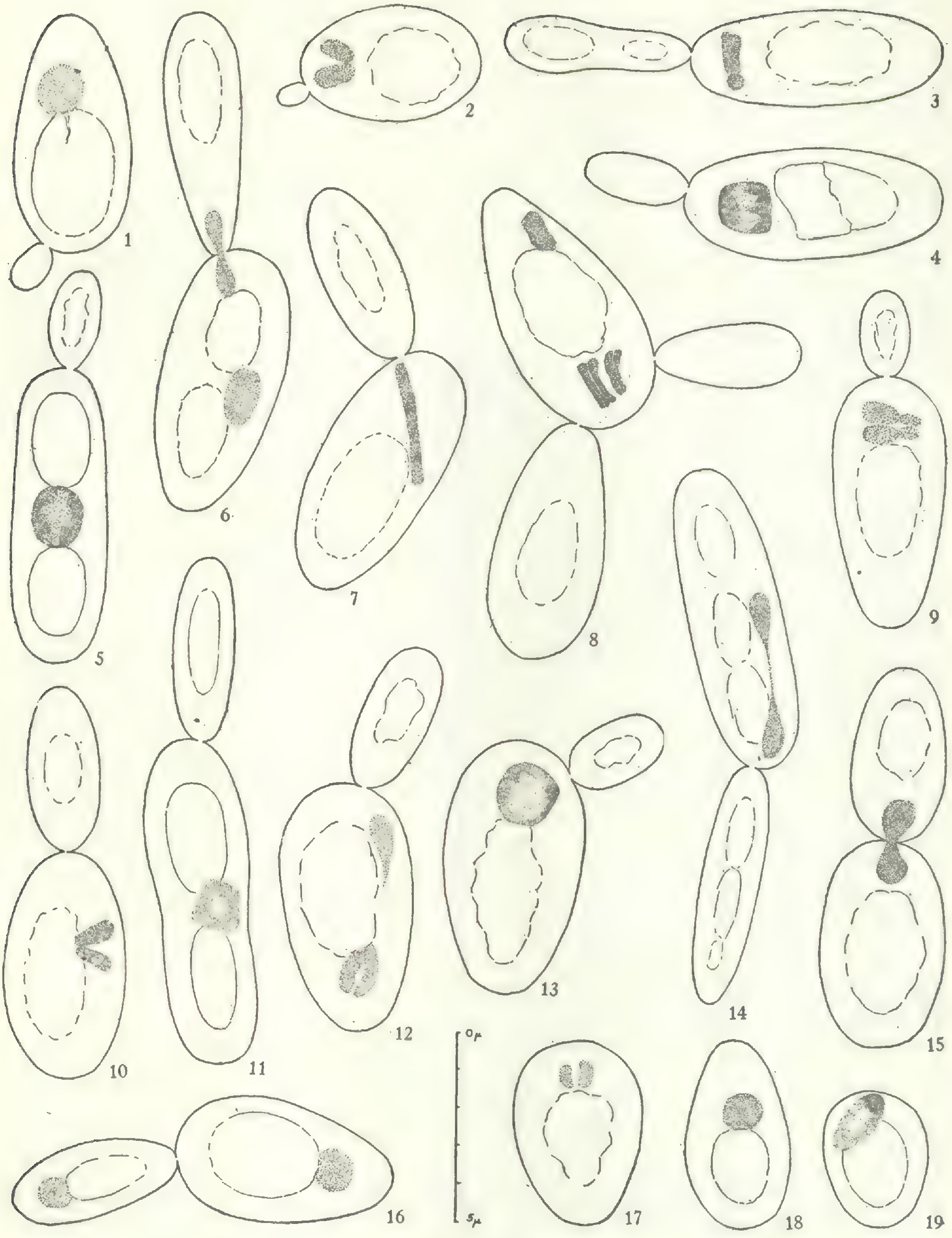
Explanation of Plate

PLATE 10

Cells from budding culture of *Saccharomyces cerevisiae* (Feulgen technique).

Figs. 1–19. Shaken broth culture, diploid (LK) strain, mercuric chloride fixation.



Budding material—Feulgen

NAGEL—SACCHAROMYCES CEREVISIAE

Explanation of Plate

PLATE 11

Cells from budding cultures of S. *cerevisiae* (Robinow's Giemsa technique)—all 12–24-hr. broth cultures except fig. 46.

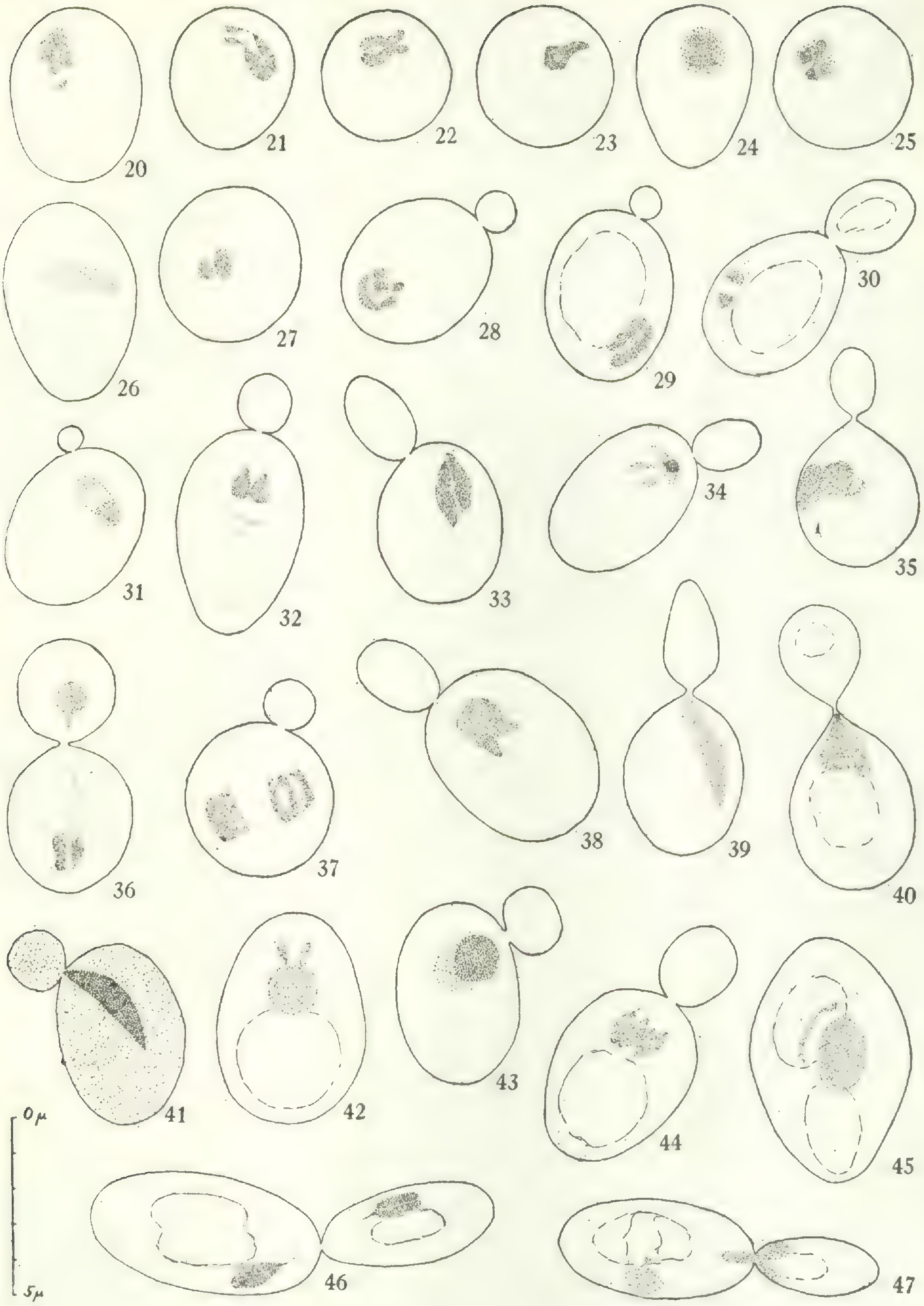
Figs. 20–41, 43. Haploid (Bc20—) strain.

Figs. 42, 44, 45, 47. Diploid strains.

Fig. 46. Budding cell from sporulating culture 24 hrs. on gypsum slant, diploid intra-specific hybrid.

Figs. 20–34, 38–42, 44, 45, 47. Iodine-glacial acetic acid-formalin fixation.

Figs. 35–37, 43, 46. Mercuric chloride fixation.



Budding material — Giemsa

NAGEL—SACCHAROMYCES CEREVISIAE

Explanation of Plate

PLATE 12

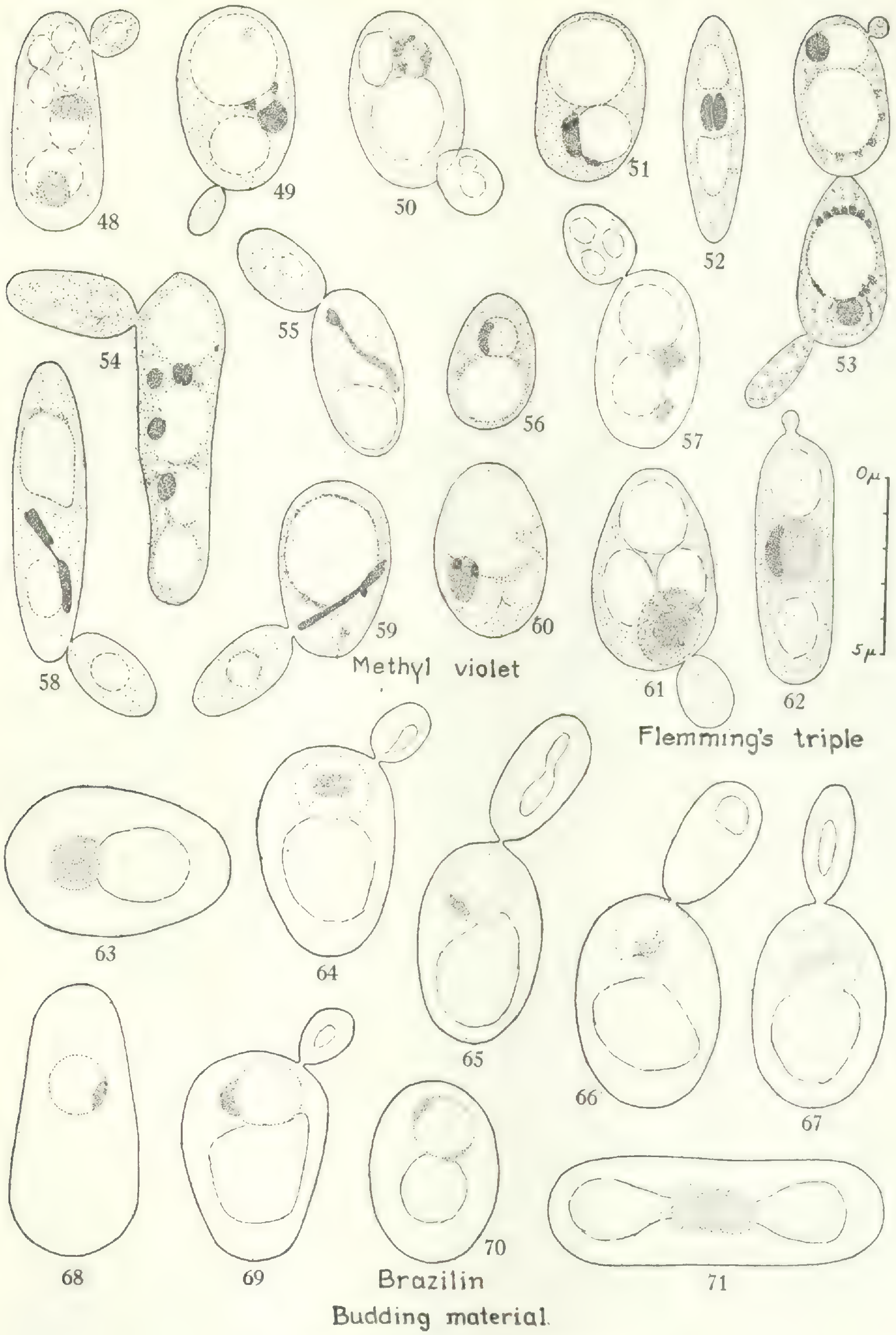
Cells from budding cultures of S. *cerevisiae* (methyl violet, Flemming's triple, or Brazilin technique).

Figs. 48–60. Johansen's methyl violet stain, broth culture, diploid (LK) strain, Navashin fixation (figures not drawn to scale).

Figs. 61, 62. Flemming's triple stain, otherwise as above.

Figs. 63, 68, 71. Brazilin (with short destaining), non-sporulating cells from gypsum slant, diploid (LK) strain, mercuric chloride fixation.

Figs. 64–67, 69, 70. Brazilin (with long destaining), broth culture from yield test, diploid intra-specific hybrid, mercuric chloride fixation.



NAGEL—SACCHAROMYCES CEREVISIAE

Explanation of Plate

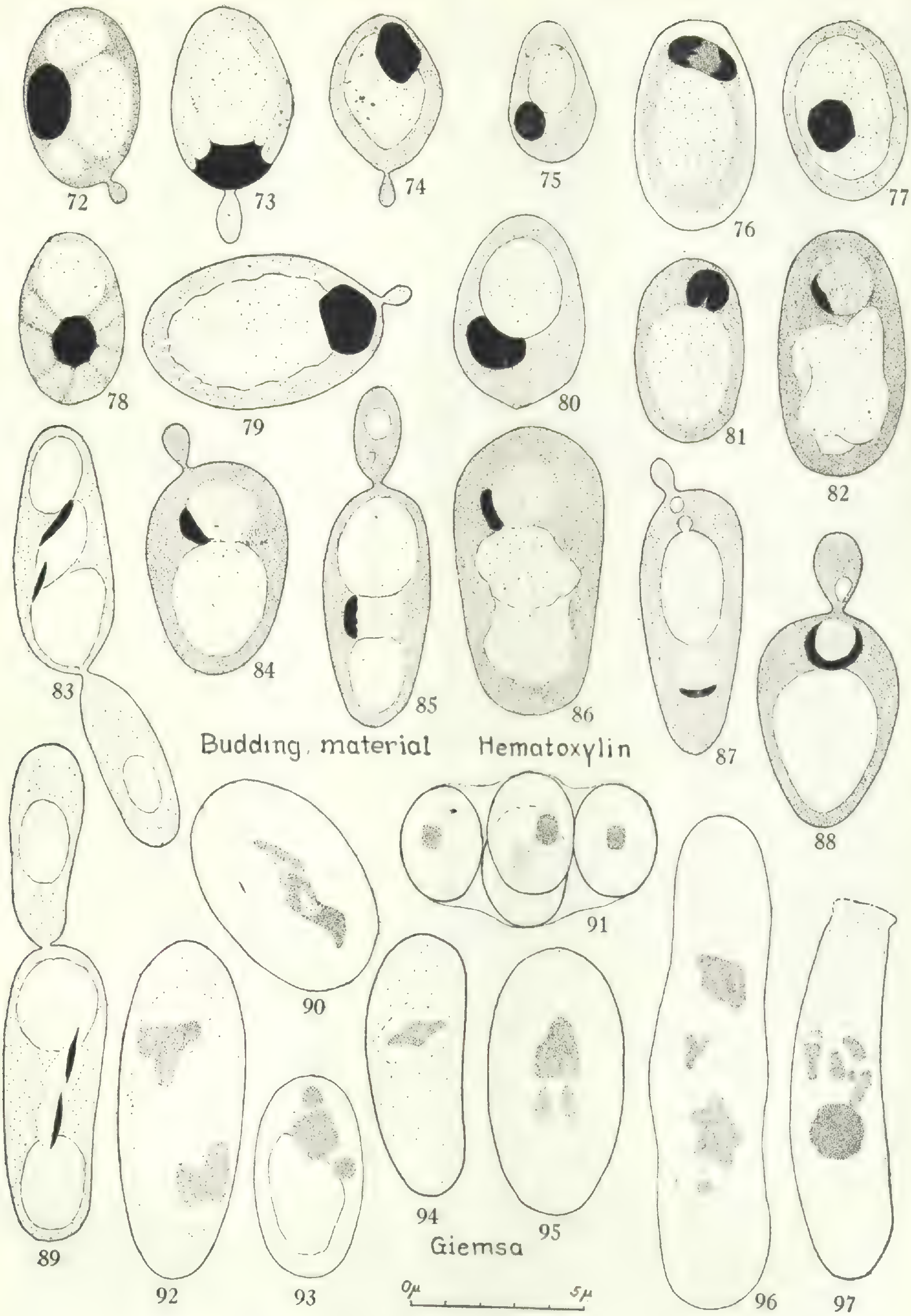
PLATE 13

Cells from budding culture of S. *cerevisiae* (Heidenhain's hematoxylin) and from agar slant (Robinow's Giemsa technique).

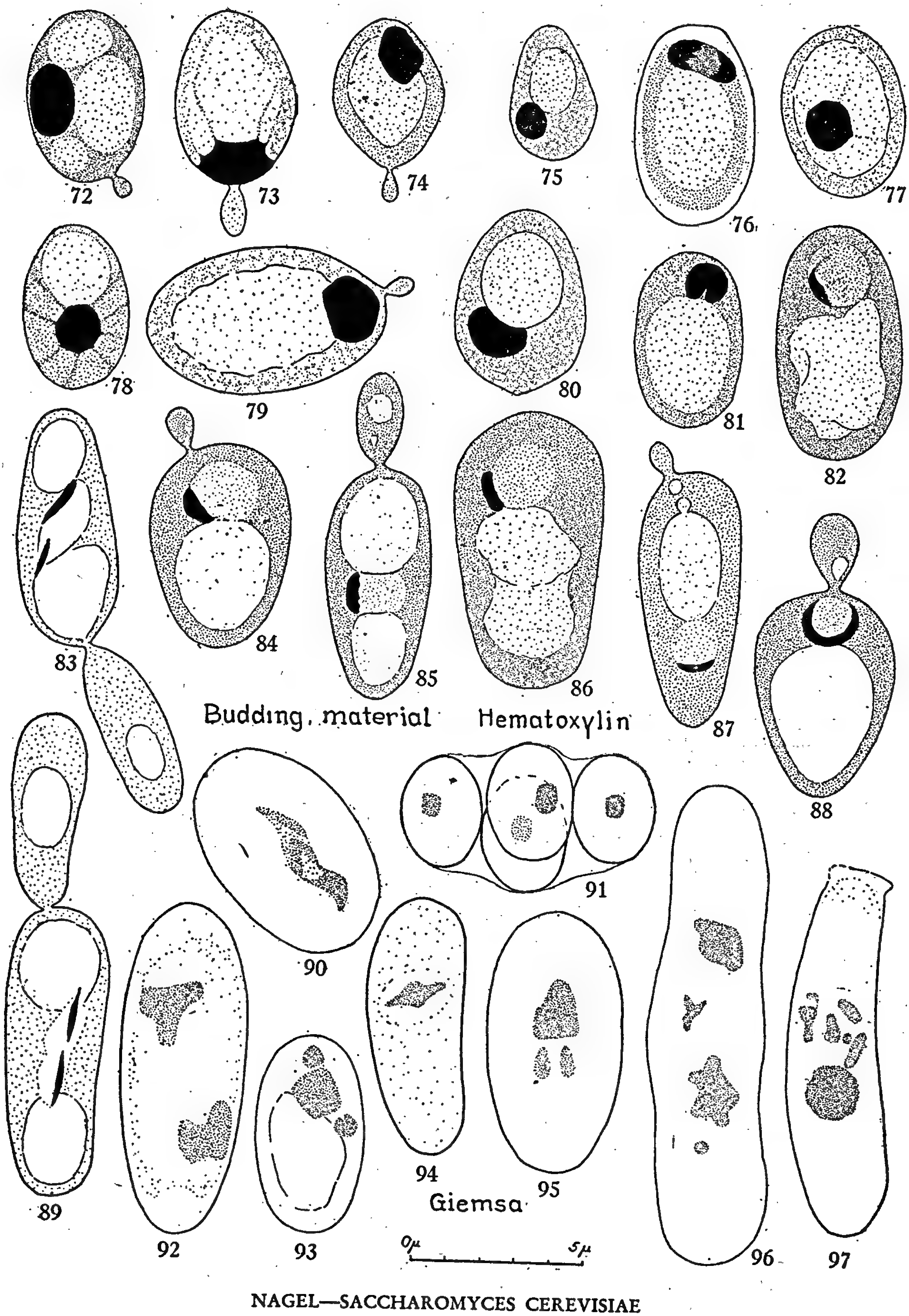
Figs. 72–81. Heidenhain's hematoxylin stain (5a, Table III), 24-hr., unshaken broth culture, diploid (LK) strain, mercuric chloride fixation.

Figs. 82–89. Heidenhain's hematoxylin stain (5b, Table III), otherwise as above.

Figs. 90–97. Robinow's Giemsa stain, 7-week-old nutrient agar slant, diploid (LK) strain, osmic acid vapor fixation.



NAGEL—SACCHAROMYCES CEREVISIAE



NAGEL—SACCHAROMYCES CEREVISIAE

Explanation of Plate

PLATE 14

Cells from budding cultures of S. *cerevisiae* (methylene blue-eosin or aceto-orcein technique) and from sporulating cultures (Feulgen technique).

Figs. 98–107. Methylene blue-eosin stain, 48-hr., unshaken broth culture, diploid intra-specific hybrid, fixation in sat. picric acid in 70 per cent alcohol.

Fig. 108. Methylene blue-eosin stain; 4-hr. shaken yield test, broth culture, diploid, osmic acid vapor fixation.

Figs. 109–112. Same as figs. 98–107 except culture was shaken.

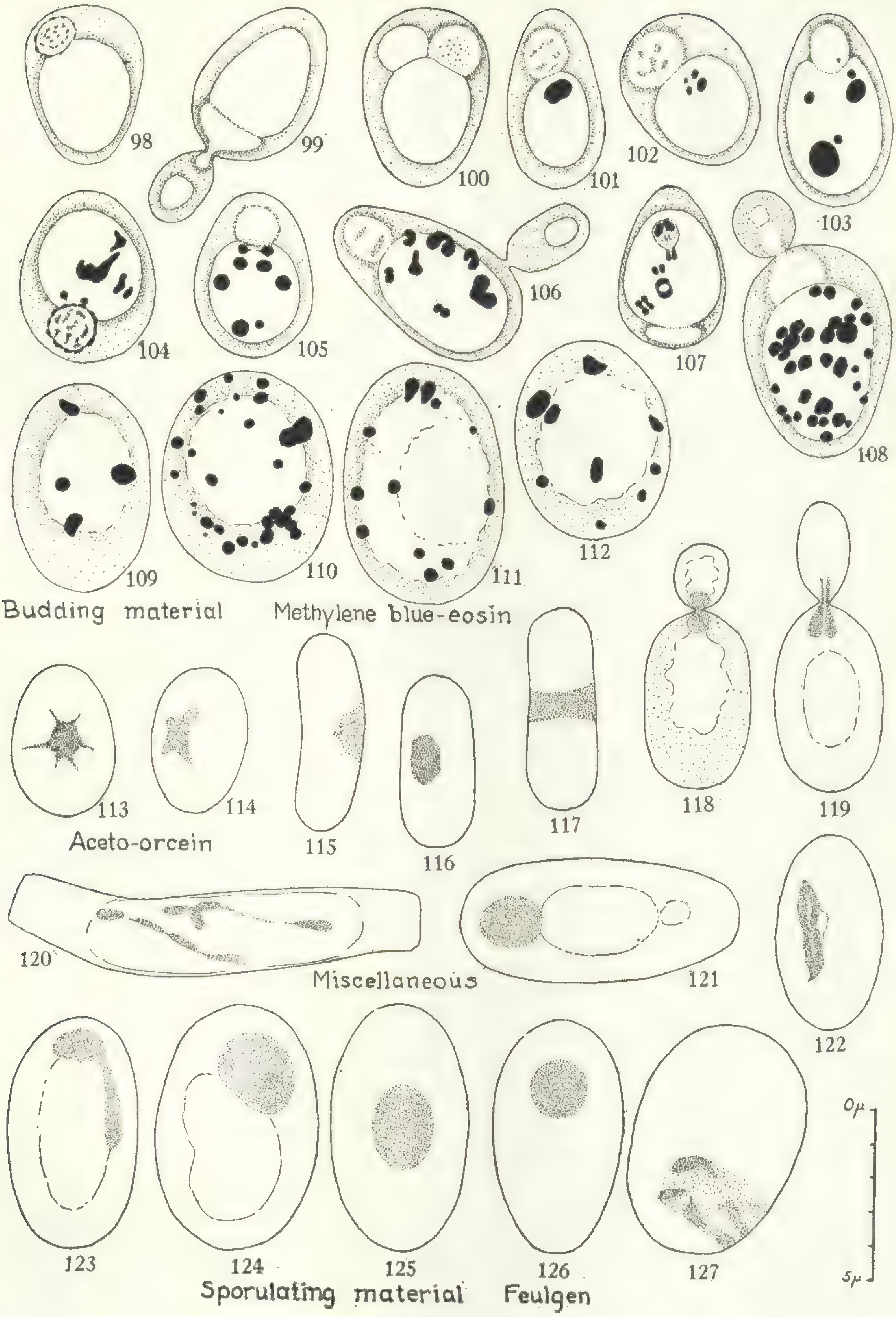
Figs. 113–117. Aceto-orcein stain, edge cells from giant colonies, various haploid strains.

Figs. 118, 119. Aceto-orcein stain, budding cells from sporulating culture 24 hrs. on gypsum slant, diploid (EFF) strain.

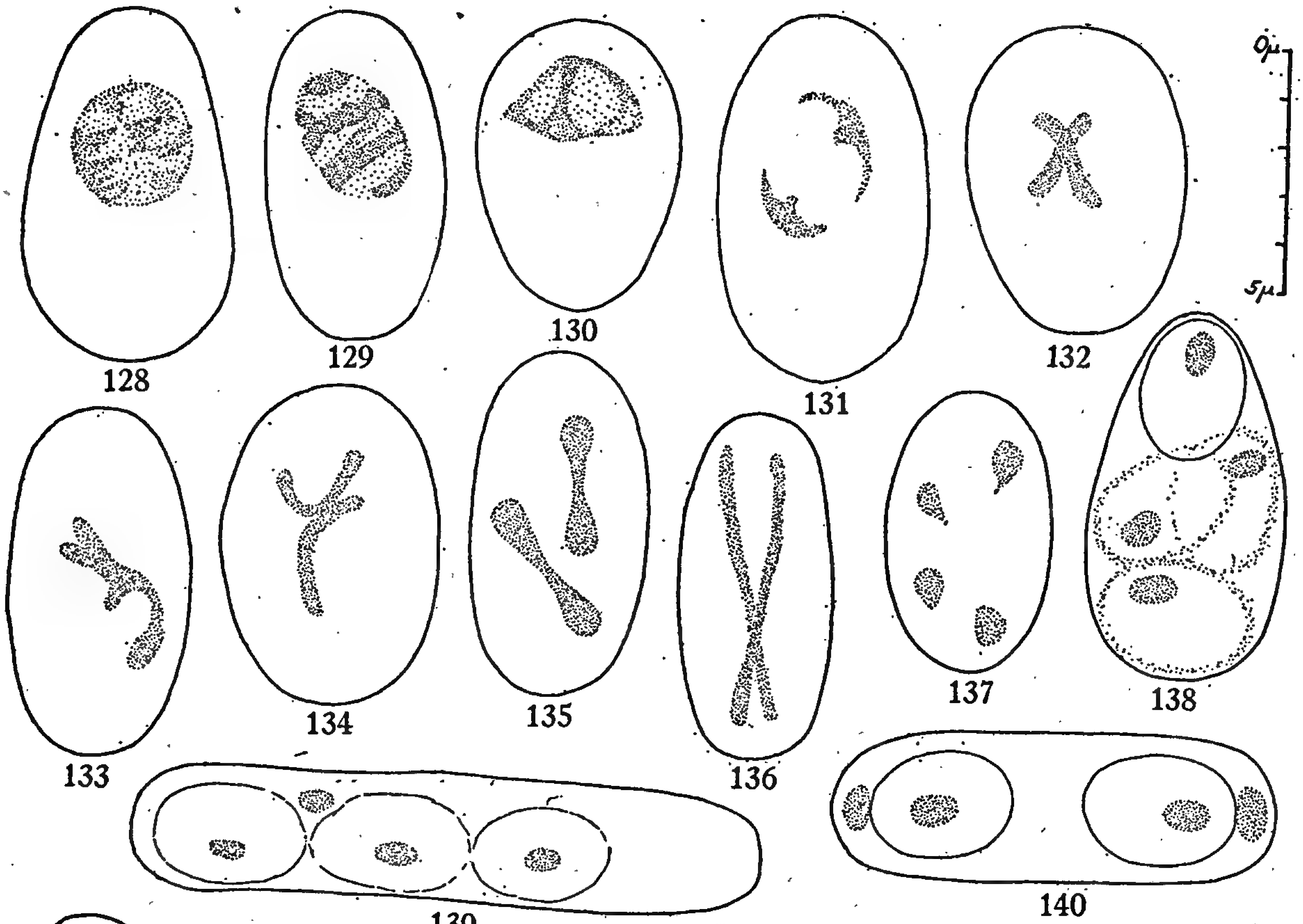
Figs. 120, 122. Robinow's Giemsa stain, week-old nutrient agar slant, diploid (EFF) strain, osmic acid vapor fixation.

Figs. 121, 124–126. Feulgen stain, 48 hrs. on presporulating medium, diploid (LK) strain, mercuric acid fixation.

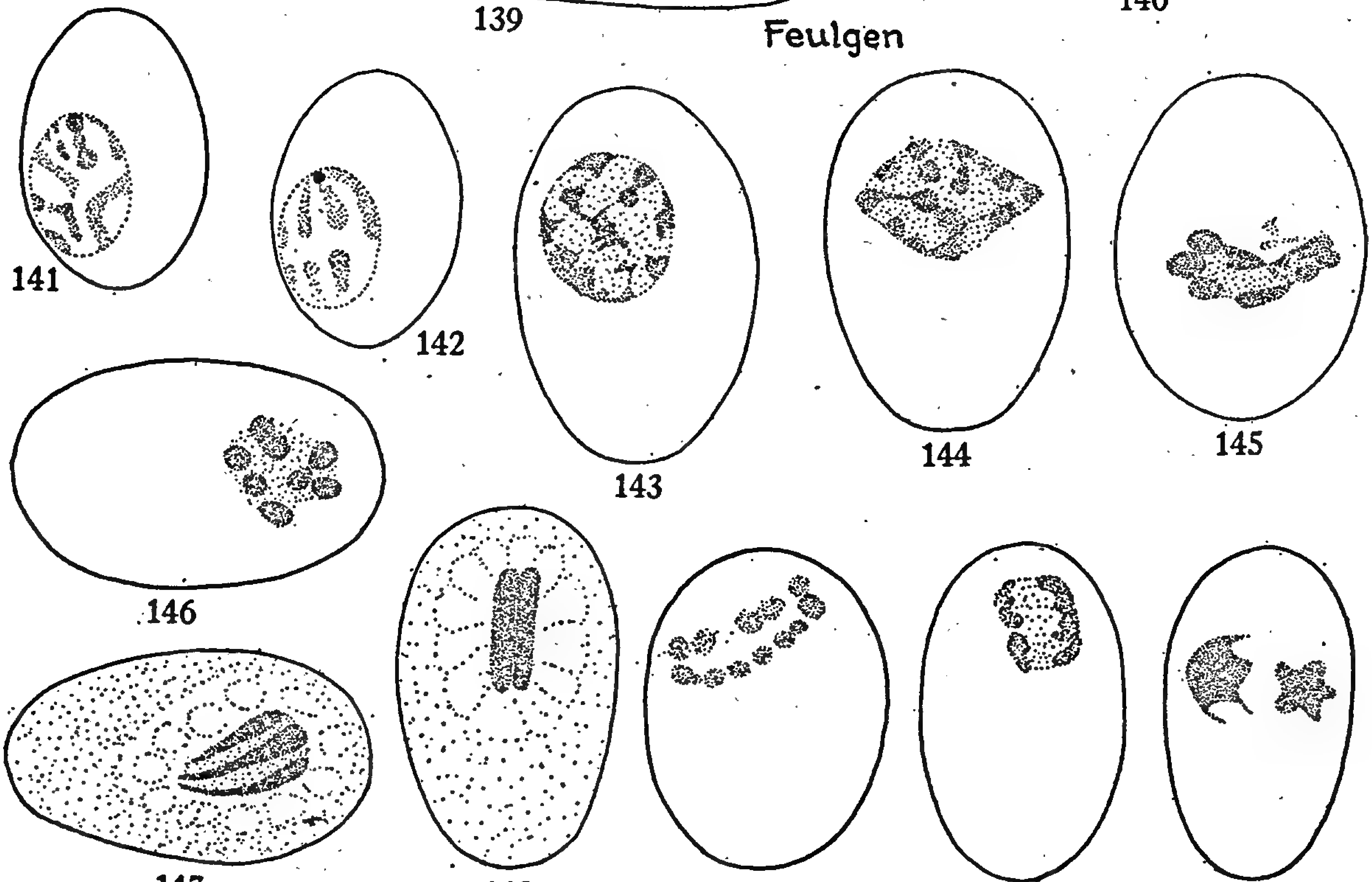
Figs. 123, 127. Feulgen stain, sporulating culture 17 hrs. on gypsum slant, diploid (LK) strain, mercuric acid fixation.



NAGEL—SACCHAROMYCES CERÉVISIAE



Feulgen



Giemsa
Sporulating material

NAGEL—SACCHAROMYCES CEREVISIAE

Explanation of Plate

PLATE 16

Cells from sporulating cultures of S. *cerevisiae* (Robinow's Giemsa, Heidenhain's hematoxylin, or Brazilin technique).

Figs. 152–164. Robinow's Giemsa stain, sporulating culture 24 hrs. on gypsum slant, diploid, mercuric chloride fixation.

Figs. 165–169. Heidenhain's hematoxylin stain (5a, Table III), sporulating culture 16 hrs. on gypsum slant, diploid (LK) strain, fixation in 48 per cent sat. aq. mercuric chloride, 2 per cent glacial acetic acid, 50 per cent picric acid.

Figs. 170–175. Brazilin stain, otherwise as above.

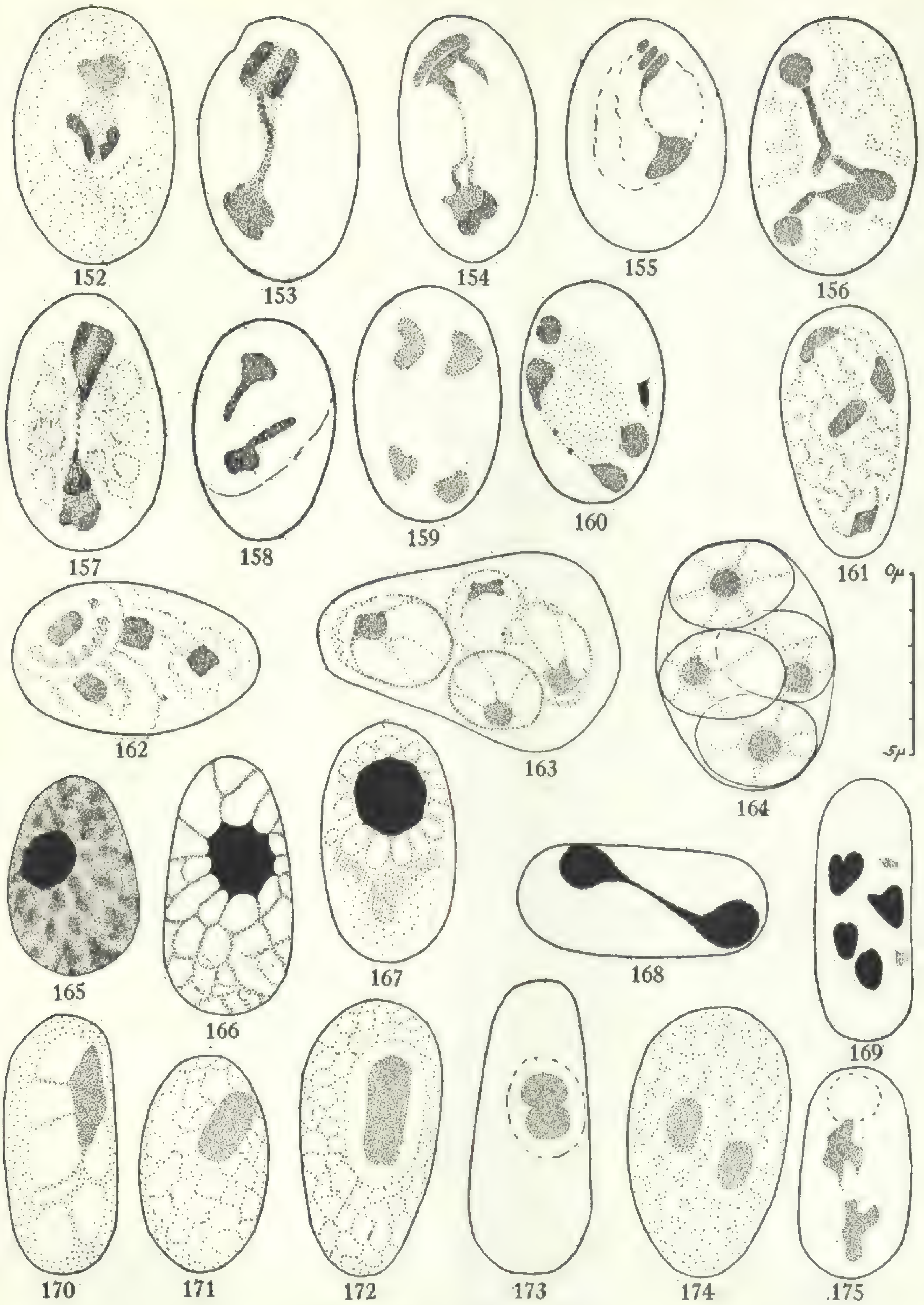
Explanation of Plate

PLATE 15

Cells from sporulating cultures of S. *cerevisiae* (Feulgen or Robinow's Giemsa technique).

Figs. 128–140. Feulgen stain, sporulating culture 17 hrs. on gypsum slant, diploid (LK) strain, mercuric chloride fixation.

Figs. 141–151. Robinow's Giemsa stain, sporulating culture 24 hrs. on gypsum slant, diploid, mercuric chloride fixation. Figs. 141, 142 are same cell shown at two levels (smaller scale than other figures).



Sporulating material

NAGEL—SACCHAROMYCES CEREVISIAE

Explanation of Plate

PLATE 17

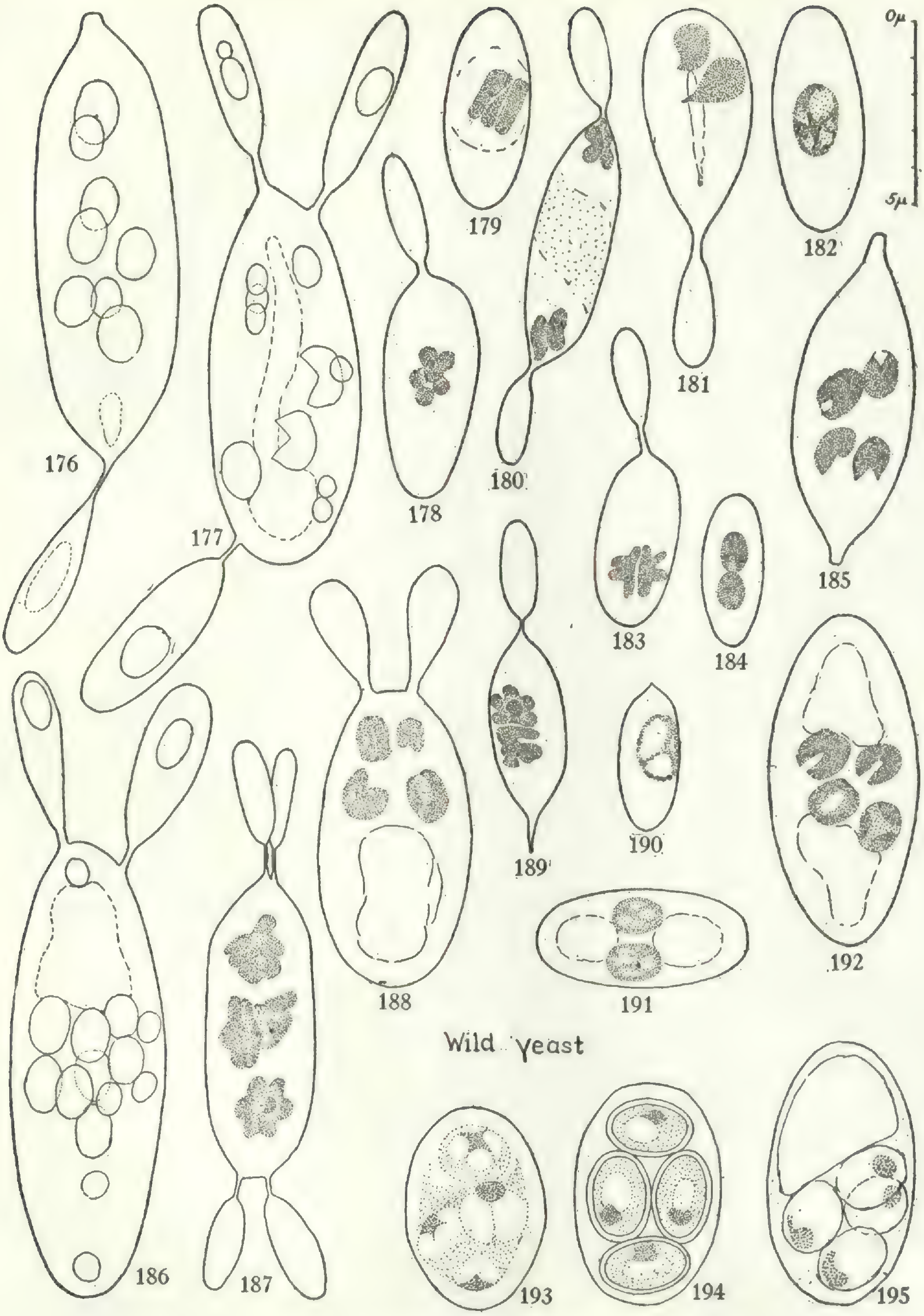
Budding cells of wild yeast (Robinow's Giemsa or Feulgen technique) and sporulating cells of S. *cerevisiae* (aceto-orcein or Robinow's Giemsa technique).

Figs. 176–190. Robinow's Giemsa stain, 24-hr. agar slant, wild yeast, osmic acid vapor fixation. In figs. 176, 177, 186 parvicorps are shown with solid outlines, magnicorps with dotted outlines.

Figs. 191, 192. Feulgen stain, otherwise as above.

Figs. 193, 194. Aceto-orcein stain, sporulating culture 24 hrs. on gypsum slant, diploid (EFF) strain.

Fig. 195. Robinow's Giemsa stain, sporulating culture 24 hrs. on gypsum slant, diploid, mercuric chloride fixation.



NAGEL—SACCHAROMYCES CEREVISIAE

CONTRIBUTIONS TO OUR KNOWLEDGE OF AMERICAN CARBONIFEROUS FLORAS

IX. Some Petrified Seeds from Iowa

ELLEN M. KERN
and HENRY N. ANDREWS

This is a third contribution that has accrued from our study of the coal-ball collections of Mr. Frederick O. Thompson of Des Moines, Iowa, the two previous accounts (Parts VII and VIII of "American Carboniferous Floras") giving a detailed description of the origin of the specimens. All of the fossils described herewith were found in coal balls from the Urbandale mine located immediately west of Des Moines.

During the decades that have elapsed since the time of Brongniart's ('81) foundational memoir on the silicified seeds from Saint-Etienne a rather vast assemblage of fossil seeds have been described from Paleozoic deposits. Although relatively few have been found attached to the plants that bore them they have contributed very appreciably to our knowledge of the three great groups of Carboniferous seed-bearing plants—the Pteridospermeae, Cordaitales, and Lycopodiales. Comprehensive summaries of the many genera and species are included in the works of Seward ('17) and Arnold ('38).

With the exception of *Lepidocarpon,* few structurally preserved seeds have been recorded from the Carboniferous of North America, most of the known species having been found in European deposits. There is now some evidence to indicate that certain areas of the Pennsylvanian forests of Illinois were predominantly pteridophytic, and since much of the American coal-ball work to date has been confined to collections from that state the apparent paucity of seeds is accounted for at least in part. It should be added, however, that only a few of the coal mines of even Illinois have been subjected to intense study, and it will certainly be some years before we arrive at a clear picture of the composition of the ancient forests that are represented in the coal balls. In a previous discussion a brief contrast was drawn between the coal-ball flora of Illinois and that of Iowa, seeds being present in Iowa in much greater numbers. Although there are at least seven species of seeds, exclusive of *Lepidocarpon,* in our present collection we have selected for description only the better-preserved ones.

Conostoma Williamson, 1877.

Conostoma oblongum Williamson.

Only one specimen of this species has turned up in our Urbandale collection thus far, and since it has been described with considerable precision by Oliver and Salisbury ('11) from the Lower Coal Measures of Lancashire a detailed account is not warranted here. More recently it has been reported by Krick ('32) from the

upper part of the Carbondale group at Harrisburg, Illinois.

The Iowa record given here is based on a specimen that was exposed in longitudinal section, although the cut had been made slightly beyond the median plane. The seed (pl. 18, fig. 2) measures nearly 4.5 mm. long by 2 mm. in diameter and shows no pronounced tapering toward either end. The apical portion of the nucellus (fig. 3) is quite well preserved, showing the distinctive generic features of the pollen chamber in which two pollen grains may be noted. The integument is lobed at the micropylar end, somewhat more distinctly so than in the previously described specimens.

Conostoma oblongum is described by Oliver and Salisbury as being platyspermic although in their own words it is "only trifling in amount," and their figures adequately bear this out. In view of the general wide range in cross-sectional shape of the petrified Carboniferous seeds there can be little doubt that more fundamental structural features, such as the organization of the pollen chamber and the nature of the integument, are of greater significance. In other words, Seward's classification of the Paleozoic seeds into three groups, the Lagenostomales, Trigonocarpales, and Cardiocarpales, is certainly preferable to the older system based on cross-sectional shape.

Aside from Krick's citation of *Conostoma oblongum* in an Illinois coal ball, the only previously known American species are those described by Graham ('34). His well-executed figures of *C. platyspermum* leave no doubt as to the generic identity of this fossil, and although it is very close to *C. oblongum* its segregation as a distinct species seems justified.

Rhabdospermum Seward, 1917.

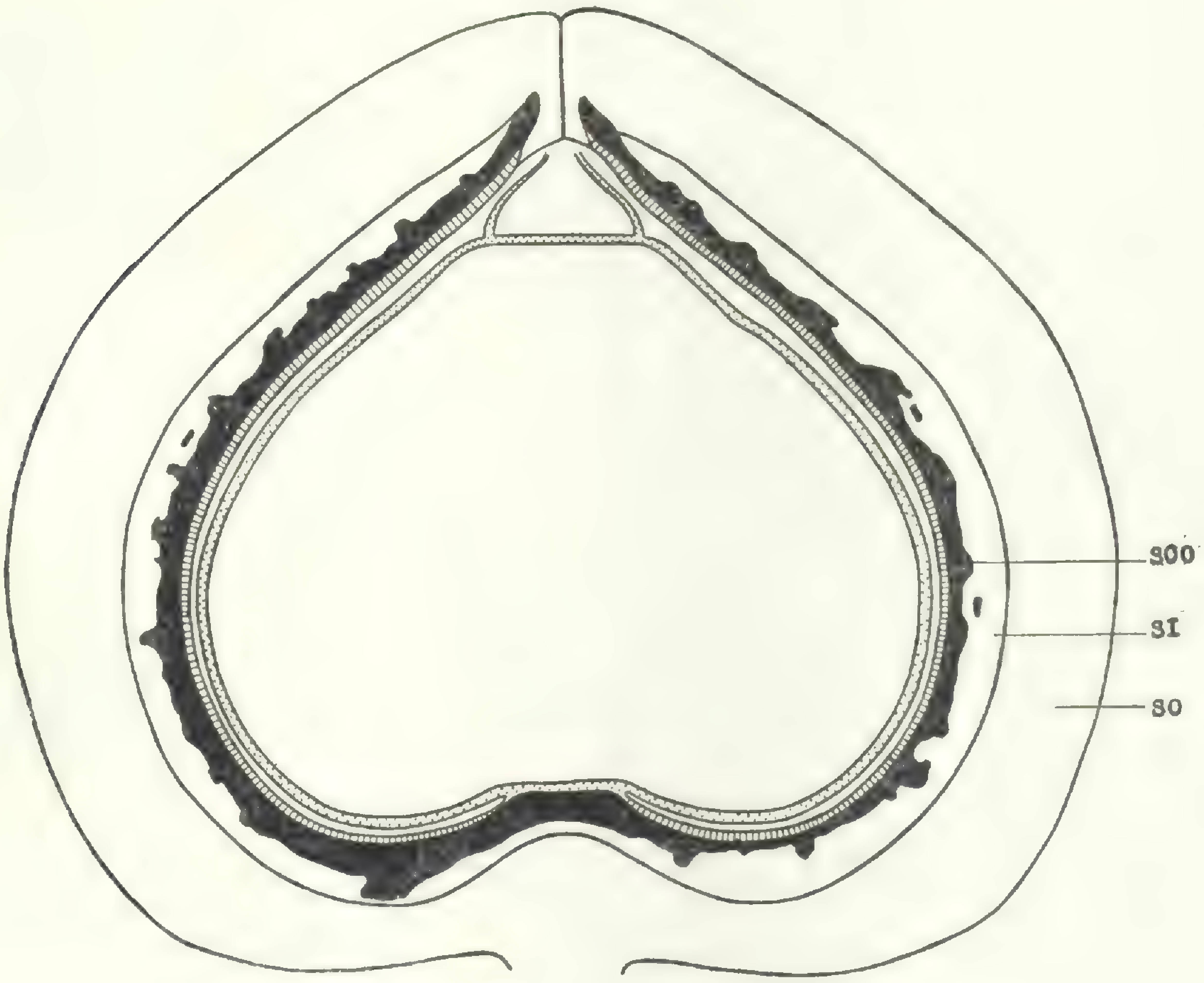
Rhabdospermum spinatum Andrews, sp. nov.

The fossil seeds, preserved as both petrifactions and impressions, that are of Cordaitean affinities already compose a striking assemblage displaying considerable variation in size, form, and anatomy. The fact that the vast majority of these seeds (included in the Cardiocarpales as classified by Seward, '17, pp. 332-356) have been described from European Carboniferous deposits by no means implies their restriction to that region. Cordaitean stem, root, and foliage remains are of frequent occurrence in the Illinois and Iowa coal balls. Although the present description is based on a single, incomplete seed, it seems worth recording inasmuch as it presents characters that distinguish it from any previously described species.

The seed is heart-shaped in longitudinal section and relatively large, measuring 15 mm. broad by 12 mm. long. The integument, which is composed of four clearly defined tissues, is especially well preserved. Following the nomenclature used by most previous workers, the outer two tissues will be referred to as the *sarcotesta* and the inner, more sclerotic two, as the *sclerotesta* (text-figs. 1, 2).

The outer sarcotesta, which is appreciably thicker than the three inner zones

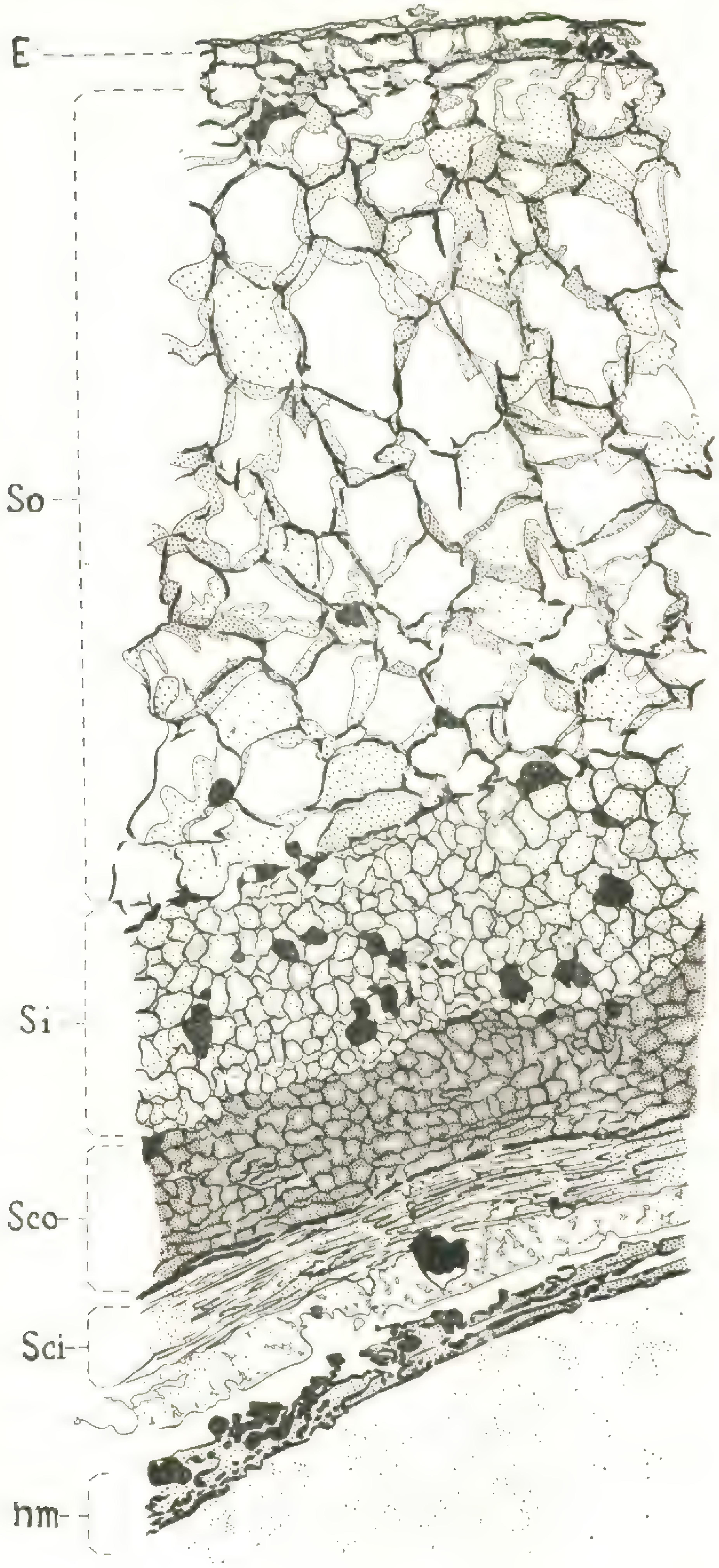
combined, is composed of large, relatively thin-walled cells averaging about 200μ[1] in diameter (text-fig. 2, So). In life this must have been of a fleshy texture, probably comparable with that of the outer coat of a *Cycas circinalis* seed. This outer sarcotesta is bounded by an epidermis of much smaller, vertically elongated cells averaging about 115μ x 70μ. The cells of the inner sarcotesta (Si) are nearly isodiametric, like those of the outer tissue, although much smaller, averaging 50μ.



Text-fig. 1. *Rhabdospermum spinatum.* Diagram of the seed shown in median longitudinal section, with pollen chamber restored: SO, outer sarcotesta; SI, inner sarcotesta; SCO, outer sclerotesta.

The sclerotesta appears as a conspicuous dark brown band, the color being due partly to the cellular contents. Like the sarcotesta, it is composed of two clearly defined tissues (text-fig. 2, Sco, Sci), although relatively much thinner and not as readily distinguishable at lower magnifications (pl. 18, fig. 1). The outer component (Sco) consists of cells similar in shape to those of the inner sarcotesta

[1]All cell measurements of these integumentary tissues have been taken from the plane of the nearly median longitudinal section shown in pl. 18, fig. 1.



Text-fig. 2

Rhabdospermum spinatum

Cellular detail taken from the equatorial region: E, epidermis; So, outer sarcotesta; Si, inner sarcotesta; Sco, outer sclerotesta; Sci, inner sclerotesta; nm, remnants of nucellus and megaspore membrane.

although thicker-walled. The most conspicuous feature of this tissue is the irregularly shaped spines projecting into the inner sarcotesta, and it is in recognition of this character that the specific name has been chosen. The inner sclerotesta consists of cells that are very poorly preserved but which apparently were elongated in the plane of the longitudinal axis.

The remnants of the nucellus are clearly attached to a raised cushion at the base of the seed although it otherwise appears to be quite free from the integument. It should be noted that, since the innermost tissues of the sclerotesta and of the adjoining nucellar tissue are not perfectly preserved, it is not certain whether the two were originally in organic connection. Yet the space between them is so uniform as to imply that it is natural rather than due to shrinkage or decay.

Very little remains of the nucellar tissue. At its apex, however, it appears to have developed in the form of a broad conical pollen chamber (pl. 18, fig. 1, text-fig. 1). Although little more than the cuticularized remains of the epidermal cells are left, the form of the integument in this region also suggests such a terminal structure of the nucellus. Thus the internal conical cavity presents a distinct contrast to the flattened one in *Rhabdospermum cyclocaryon* (Ad. Brongn.) Seward (Brongniart, '81, pl. XII, fig. 1).

Affinities:—The affinities of this seed appear to lie with the closely related genera *Cardiocarpus*, *Rhabdospermum* and *Mitrospermum* of the Cardiocarpales. The last two of these genera are distinguished from *Cardiocarpus* chiefly in the way that the vascular strands originate from the main bundle. In *Cardiocarpus* the outer (lower) bundles depart from the main vascular axis before the latter reaches the sclerotesta, while in *Rhabdospermum* and *Mitrospermum* they are given off from the sclerotesta region and recurve back into the outer portion of the integument (cf. Seward, '17, figs. 500B and 501E).

As stated above, the only available specimen of this seed was exposed on a previously cut slab from Mr. Thompson's collection. The fact that the initial cut was apparently made directly through the central vascular strand leading up through the base of the seed makes it impossible to determine whether the integument branches departed from the main bundle before or after reaching the sclerotesta. The one observable integumentary strand passes out between the outer and inner sarcotesta, more closely comparable with the position of the bundles in *Rhabdospermum* (Seward, '17, fig. 501E) than in *Cardiocarpus* (Seward, '17, fig. 500B). Moreover, the strikingly distinct integumentary tissues of *Rhabdospermum spinatum* compare very closely with *Rhabdospermum cyclocaryon* (see Brongniart, '81, pl. XII, fig. 3). The spinose nature of the sclerotesta of the new seed sets it apart from *R. cyclocaryon* or the apparently closely related *Mitrospermum compressum* (Will.) A. Arber.

Diagnosis:—Rhabdospermum spinatum: platyspermic seed 15 mm. broad x 12 mm. long; integument composed of four tissues: an outer conspicuously thick sarcotesta, inner sarcotesta, outer spinose sclerotesta, and inner sclerotesta of longitudinally elongate cells; pollen chamber shaped like an inverted shallow teacup.

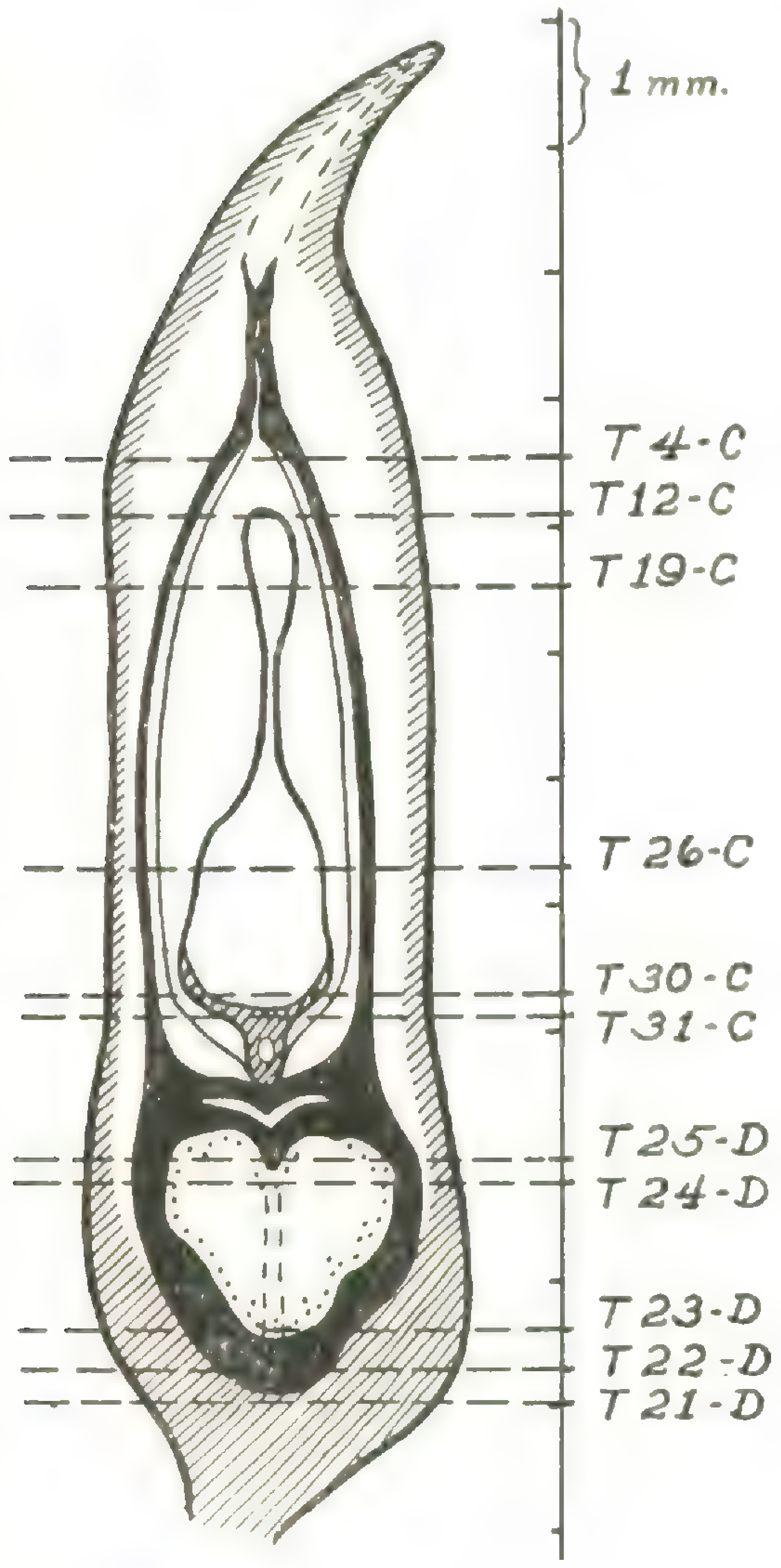
Locality: Urbandale Coal Mine, Des Moines, Iowa.

Horizon: Des Moines Series, Pennsylvanian.

Type specimen: No. WCB493, Henry Shaw School of Botany paleobotanical collections.

Kamaraspermum Leeanum Kern, gen. et sp. nov.

One of the Urbandale coal-balls received from Mr. Thompson contained a dozen or more specimens of a seed which, because of its highly distinctive structure, is designated herewith as a new species, *Kamaraspermum Leeanum*[2].



Text-fig. 3. *Kamaraspermum Leeanum.*

Diagrammatic median longitudinal section along the minor axis (from seed A, peel 475-T 21). Horizontal broken lines indicate corresponding positions of transverse sections through seeds C and D (see text-fig. 5). The seed tissues are indicated as follows:

Epidermis—outer black line.
Outer sclerotic integument—striped area.
Outer parenchymatous integument—white area.
Inner sclerotic integument—black.
Inner parenchymatous integument — white area delimited by inner sclerotic integument and thin black line.
Nucellus and megaspore membrane.
Probable course of vascular strand—broken line through basal chamber.
Parenchymatous cells of basal chamber—black dots.

[2] The prefix *Kamara* is from the Greek, meaning a chamber or room with an arched covering. The species is named for Mr. Arthur F. Lee, Chief Engineer of the Binkley Coal Company's Pyramid Mine, Pinckneyville, Illinois. Mr. Lee's most cordial cooperation during the past six years has been an indispensable aid in our coal ball collecting.

In spite of some pyritization the seeds are quite well preserved, and the orientation of two of them has allowed the preparation of satisfactory series of transverse and longitudinal peel preparations. The remaining specimens, although less completely preserved, have been useful in checking structures throughout.

The seed possesses an integument with a distinctive succession of tissues, and a large basal chamber, presumably a buoyancy mechanism which aided in water transport. The only previously described seeds with which it may be compared in a general way are those assigned to Brongniart's *Codonospermum*. However, the pronounced platyspermy of the Iowa seeds, as well as the nature of the integument, seems to render necessary a new generic name.

GENERAL ORGANIZATION—

The seed has the approximate shape of a double convex lens (pl. 19, figs. 4, 5), slightly elongated in the micropyle-peduncle axis, with an extended micropyle in the form of a flattened funnel. It measures about 12 mm. in length, and in a median transverse section the major and minor axes measure 11 and 3 mm. respectively. Thus, quite different aspects are presented, depending upon whether the longitudinal section is taken through the major (fig. 5) or minor (fig. 4) axis. In order to portray clearly the various aspects of the seed two sets of diagrammatic drawings have been prepared: one, from a series of transverse sections (text-fig. 4); and the other from a series of longitudinal sections (text-fig. 5)[3] taken through the minor axis.

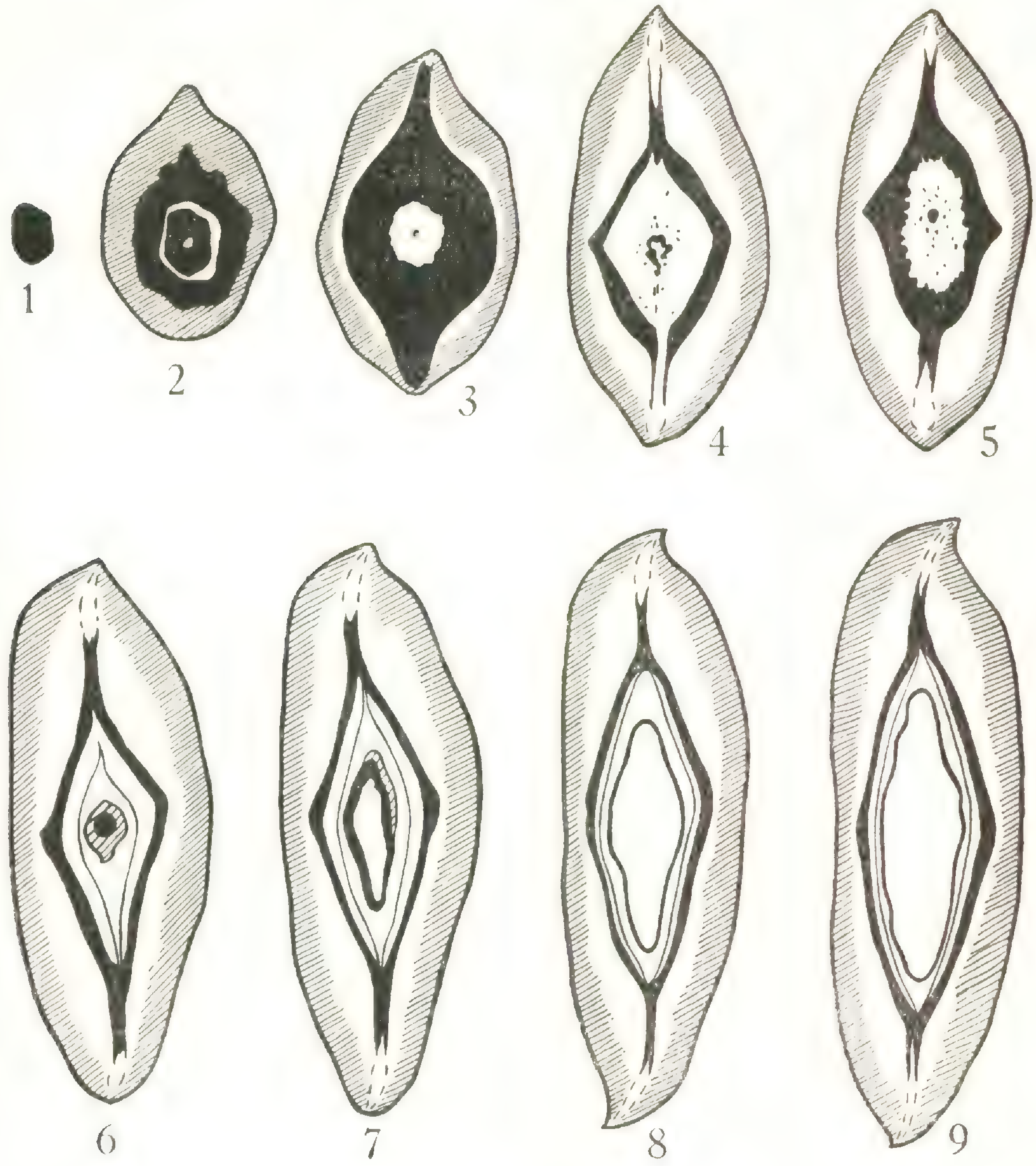
It is significant to note that the seeds, with the exception of the terminal portion of the micropyle, show no evidence of any appreciable distortion as a result of fossilization. Aside from the outer layer of the nucellus and whatever may have been within the megaspore membrane at the time the seeds were deposited, the tissues are well preserved and the gross shape as outlined in the text figures presents the true life form of the seed.

A longitudinal section (pl. 19, fig. 4, and text-fig. 3) shows that the seed is composed of two clearly defined regions: a basal chamber and nucellar chamber, with their attendant tissues. Simply as a matter of convenience these will be described separately.

NUCELLAR REGION—

Integument:—The integument is bounded externally by a single layer of epidermal cells which appear brick-shaped in both longitudinal and transverse sections. Within this epidermis is a succession of four clearly defined tissues. First

[3]All the seeds on which this description is based were contained in one small coal-ball specimen; thus it was not possible to prepare individual preparations of peels. Consequently in the longitudinal series shown in text-fig. 5 the preparations are slightly oblique, showing the micropyle or basal chamber more perfectly at one end than the other (cf. Nos. 2 and 3 with Nos. 15 and 16).



Text-fig. 4. *Kamaraspermum Leeanum.* A series of diagrammatic drawings of transverse sections extending from below the basal chamber to the top of the nucellar chamber.

1. Sclerotic tissue below basal chamber. Seed D, peel 475-T21.

2. Lowermost part of basal chamber containing prominent central vascular strand. Seed D, peel 475-T22.

3. Lower part of basal chamber. Seed D, peel 475-T23.

4. Upper part of basal chamber. Seed D, peel 475-T24.

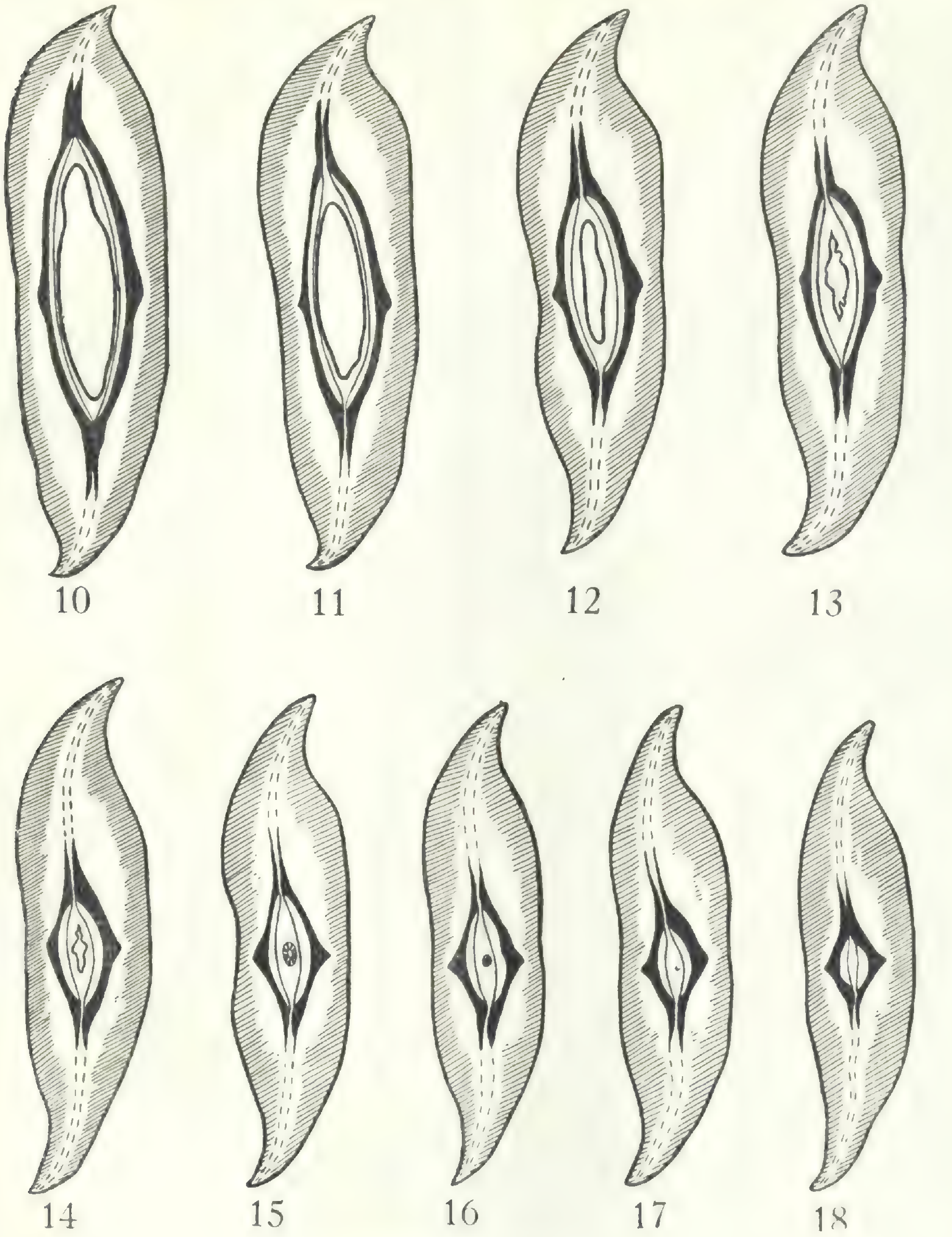
5. Top of basal chamber. Seed D, peel 475-T25.

6. Lower part of nucellar chamber, near nucellar attachment. This and the remaining figures in this series are from Seed C. Peel 475-T31.

7. Lower part of nucellar chamber. Peel 475-T30.

8. Lower third of nucellar chamber. Peel 475-T28.

9. Slightly below center of nucellar chamber. Peel 475-T26.

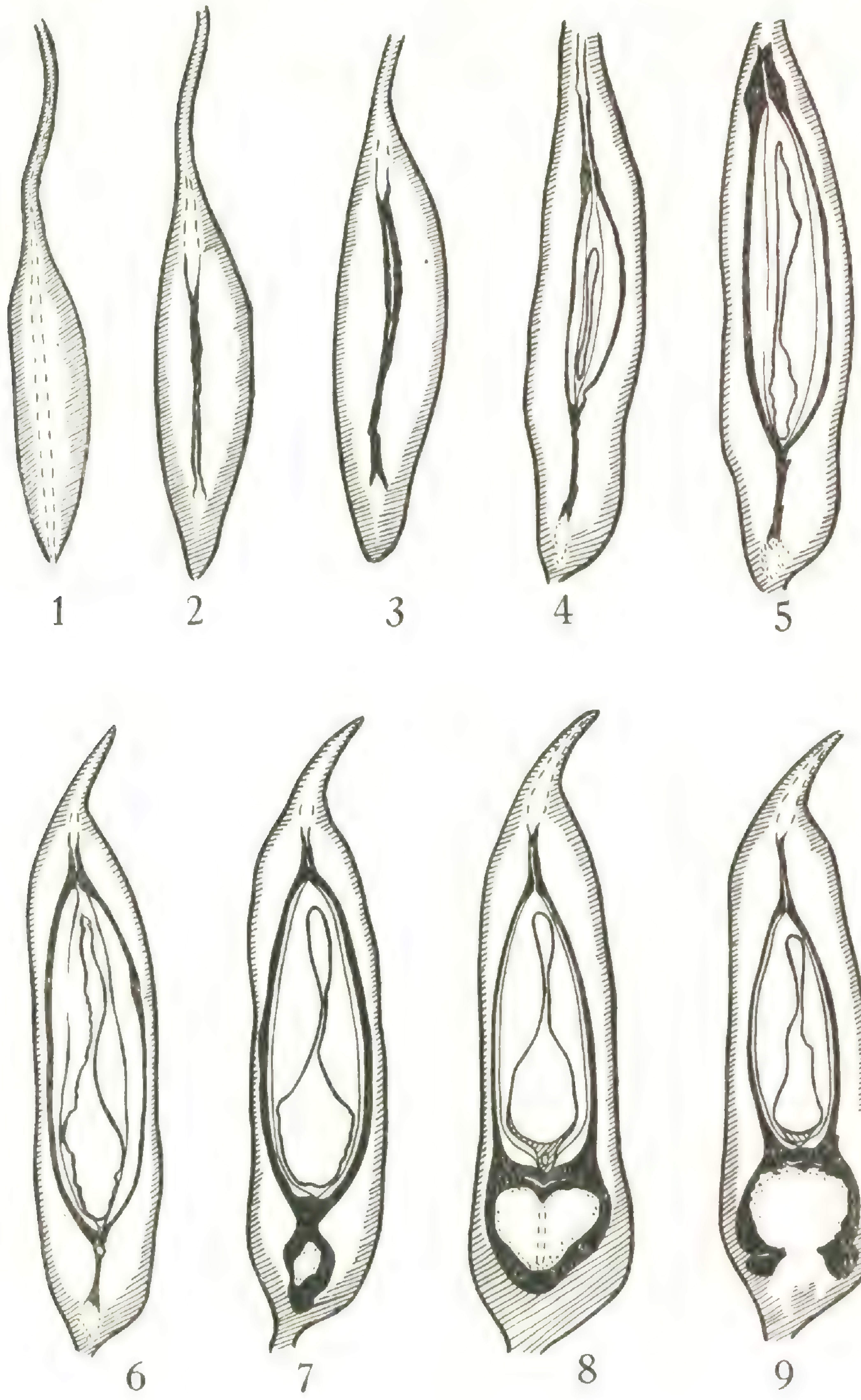


Text-fig. 4 (Continued).

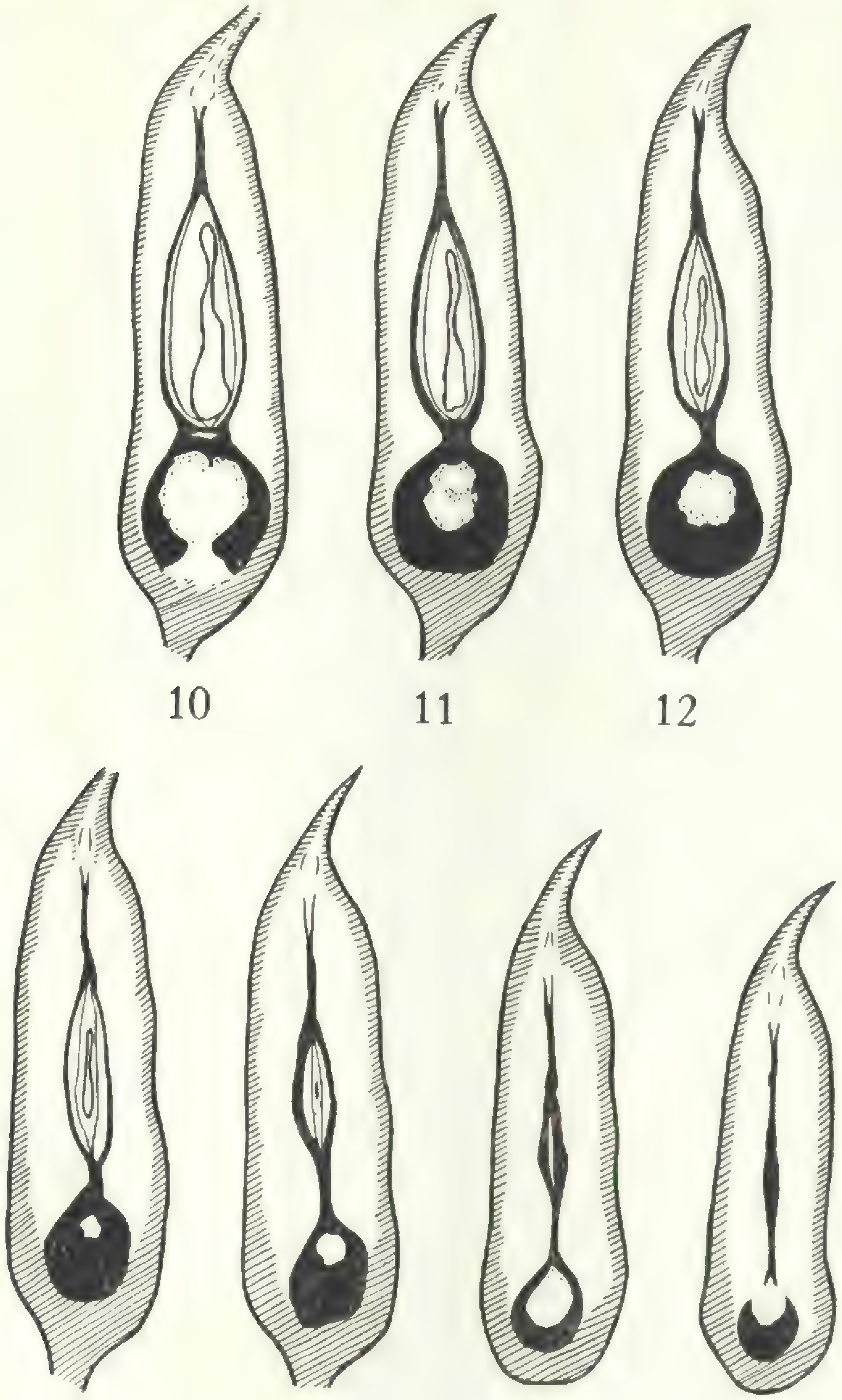
10. Slightly above center of chamber. Peel 475-T23.

11–16. From upper part of nucellar chamber. Peels 475-T21, T19, T18, T16, T15, T12 respectively.

17, 18. Top of nucellar chamber. Peels 475-T8 and T4.



Text-fig. 5. *Kamaraspermum Leeanum.* A series of diagrammatic drawings of longitudinal sections taken parallel to the minor axis of the seed. From seed A.



10 11 12

13 14 15 16

Text-fig. 5. (Continued).

1, peel 475-T33; 2, T32; 3, T31; 4, T28; 5, T26; 6, T24; 7, T23; 8, T21; 9, T19; 10, T18; 11, T16; 12, T13; 13, T11; 14, T7; 15, T5; 16, T2.

is a dark-colored layer, three or four cells thick, of rather large, irregularly shaped, thick-walled cells. Within this outer sclerotic tissue is a conspicuous layer of light-colored parenchymatous cells, small and hexagonal when viewed in transverse or longitudinal section. This tissue is massive in the lower micropyle region of the integument (pl. 19, fig. 4), tapering down rather abruptly in the mid-nucellar region, and tends to become slightly thicker in the transition zone between the nucellar and basal chambers. The third layer, like the outermost one, is relatively narrow and consists of dark sclerotic cells. This expands to form a very conspicuous tissue between the nucellar and basal chambers. The fourth layer is narrow, and is composed of longitudinally elongate, brick-shaped parenchyma cells.

Micropyle:—The micropyle of *Kamaraspermum Leeanum* is a striking structure and deserving of special comment. As may be noted in the median (minor axis) longitudinal section (pl. 19, fig. 4; text-fig. 3), it consists of two quite distinct regions: a massive continuation of the integument above the nucellar chamber, and a much more slender tapering apex. These will be referred to as the proximal and distal portions respectively.

The structure of the proximal micropyle differs from that of the integument below it only in the great development of the parenchymatous (second) layer, and an absence of the innermost parenchymatous tissue. The distal portion of the micropyle is approximately 1.5 mm. long and shaped like a much-flattened inverted funnel, being twice as broad in the plane of the major longitudinal axis as in the minor axis. Like the proximal region, this portion consists of epidermis, outer sclerotic and outer parenchymatous layers, the inner sclerotic layer having terminated in the upper portion of the proximal region.

Nucellus:—The nucellus consists of the remnants of a thin layer of small brick-like parenchymatous cells surrounding the well-preserved megaspore membrane, and is attached to the rest of the seed only at the base. No pollen chamber was found in any of the seeds, although judging from what is known of petrified Pennsylvanian seeds in general, it seems likely that one did exist. If such were the case it was probably composed of delicate cells which were destroyed prior to fossilization.

Megaspore membrane:—This appears as an orange-colored band immediately within the nucellus. It becomes somewhat thicker at the base where the nucellus is attached to the integument, and sometimes a few scattered cells may be seen within the membrane.

BASAL CHAMBER—

The basal chamber consists of epidermis, outer sclerotic and outer parenchymatous tissue, each identical to and continuous with the respective layers of the integument surrounding the nucellar chamber. An inner sclerotic layer surrounds the chamber and appears to be a continuation of the inner sclerotic integument

around the nucellar chamber. This layer consists of irregular cells, which are smaller than those of the outer sclerotic layer but resemble them in shape. The inner edge of this sclerotic layer is somewhat irregular, with a few small scattered parenchymatous cells occasionally adjoining it. Although not present in the specimens at hand, a vascular strand (indicated by the dotted line in text-fig. 3) probably passed from the peduncle through the center of the chamber. Evidence for it is an area of vascular tissue visible in cross-sections at the base and at the top of the chamber. Furthermore, in one of the median longitudinal sections the chamber is strongly heart-shaped due to the extension of some sclerotic cells downward from the top of the chamber. The fact that some scattered thin-walled cells are found within the chamber suggests that it might have been occupied with a loose aerenchymatous tissue.

COMPARISON WITH OTHER SEEDS—

Kamaraspermum presents a number of structural features that render it of very great interest, yet at the same time preclude it being assigned definitely to the recognized orders of Paleozoic seeds (Seward, '17, pp. 300–365). The strong bilateral symmetry and lack of any semblance of trigonocarpous organization in transverse section seem to rule out the Trigonocarpales. In at least three important respects it diverges from characteristic Lagenostomalean seeds: *Kamaraspermum* is strongly platyspermic; the nucellus is free from the integument; and the integument as a whole is comparatively thick. Its affinities lie closer to the Cardiocarpales than either of the previous two orders, and it seems most expedient to consider it tentatively as a member of this group. The chief conflicting feature here, however, is the structure of the integument. A typical Cardiocarp seed, as the present authors understand it, has an integument with a conspicuous and bulky outer fleshy sarcotesta, while *Kamaraspermum* presents in the sequence of its integumentary tissues: first (outermost), a sclerotic layer, then a relatively fleshy layer followed by another sclerotic one.

It is also appropriate to comment briefly on the prominent basal chamber. Usually where there is a lack of tissue in a petrifaction the possibility of loss through decay exists. Yet, since the Iowa seeds are generally well preserved and a similar basal chamber occurs in the French *Codonospermum* species (Brongniart, '74, '81; Renault, '96), it appears likely that the basal chamber existed as such in life. However, since the chamber region contains some remnants of delicate tissue it may be that it was occupied by a very loosely organized aerenchyma. In either event there can be little doubt that it functioned as a float mechanism.

The possibility of Lepidocarpalean affinities has also been considered. There are certain points of similarity between *Kamaraspermum* when viewed in median longitudinal section and a tangential section of a *Lepidocarpon* taken through the "heel" or distal end of the sporophyll. The symmetry of *Kamaraspermum*, its complex integument and micropyle, nature of the remnants of the outer nucellar

tissue are, upon more critical examination, found to be in no way related to those of any described species of *Lepidocarpon.*

One is almost tempted to apply the nebulous term "missing link" to this curious fossil, with its non-conformity to established groups, yet the evidence seems to point in the direction of the Cardiocarpales, to which order it is tentatively assigned.

Diagnosis:—Kamaraspermum Leeanum: platyspermic seed 12 mm. long, 11 x 3 mm. in median transverse section; conspicuous chamber beneath nucellar region; integument composed of thin outer sclerotic layer, conspicuous fleshy layer, inner sclerotic layer, and thin inner parenchymatous tissue; micropyle of two clearly defined regions: a massive continuation of integument above nucellar chamber, and delicate distal portion shaped like a flattened funnel.

Locality: Urbandale Coal Mine, Des Moines, Iowa.

Horizon: Des Moines Series, Pennsylvanian.

Type specimen: No. WCB475, Henry Shaw School of Botany paleobotanical collections.

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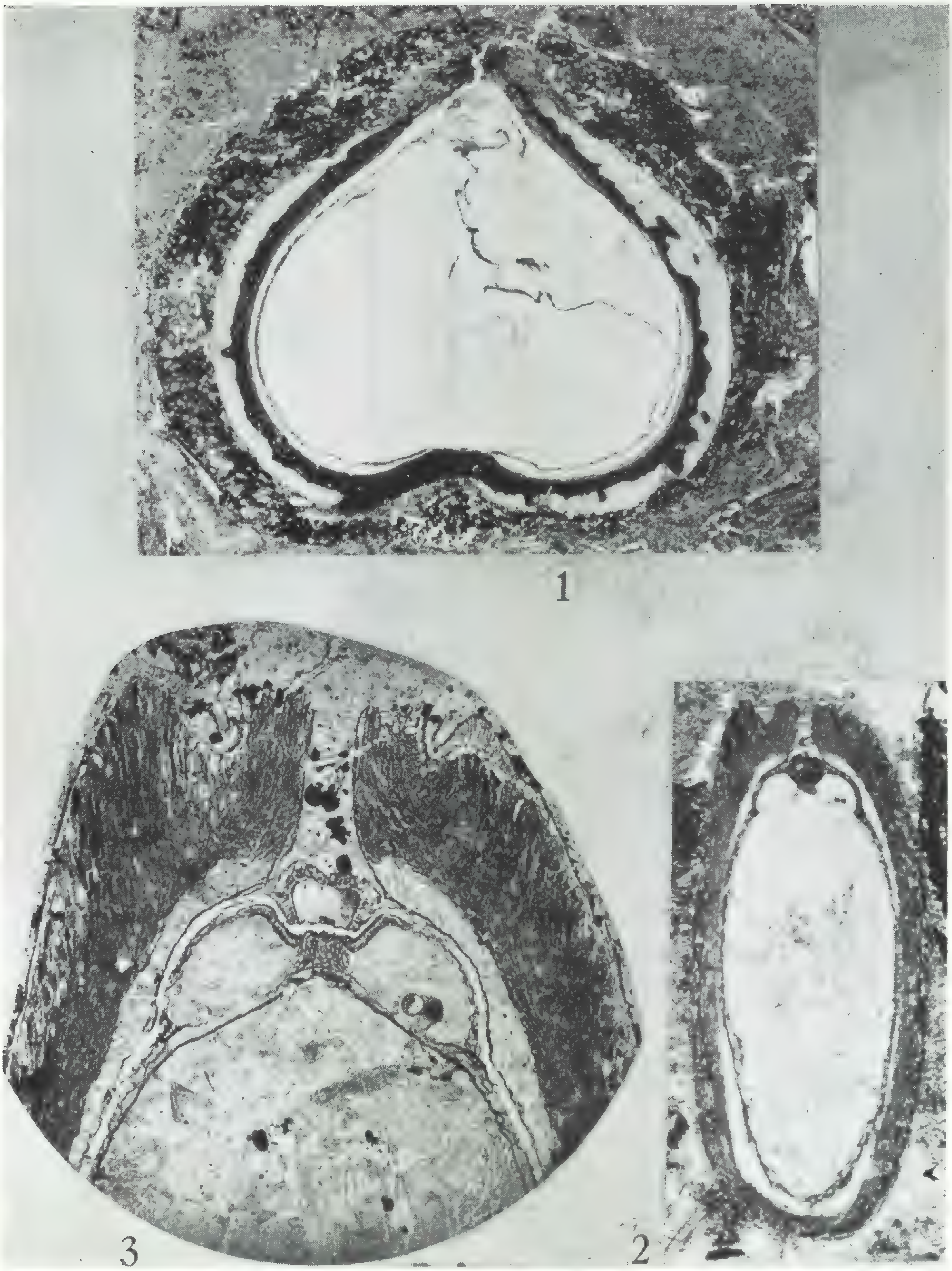
Explanation of Plate

PLATE 18

Fig. 1. *Rhabdospermum spinatum.* A nearly median longitudinal section. See text-fig. 2 for cellular structure of integument. From peel 493-T3. Magnified x 6.

Fig. 2. *Conostoma oblongum* Williamson. A nearly median longitudinal section through the seed. From slide 1398. Magnified x 13.5.

Fig. 3. The micropylar region of the seed shown in fig. 2, at a higher magnification. From slide 1398. Magnified x 41.



KERN & ANDREWS—AMERICAN CARBONIFEROUS FLORAS. IX

Explanation of Plate

PLATE 19

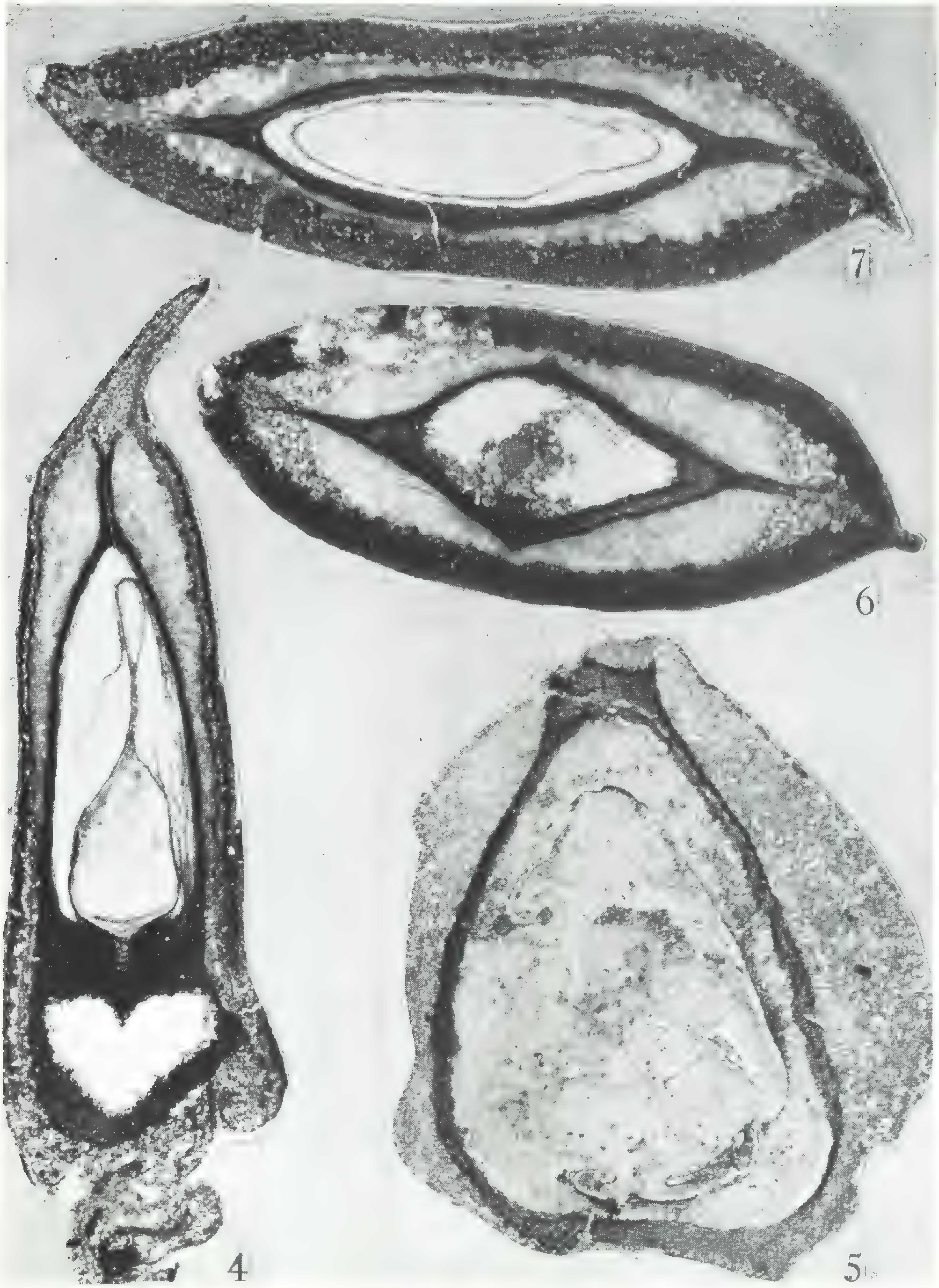
Kamaraspermum Leeanum Kern

Fig. 4. Median longitudinal section along minor axis. Seed A, peel 475-T21. x13.

Fig. 5. Longitudinal section along major axis. Peel 475-T14. x 12.

Fig. 6. Transverse section through lower part of nucellar chamber, just above point of nucellar attachment. Seed C, peel 475-T26. x 12.

Fig. 7. Transverse section through central portion of nucellar chamber. Seed C, peel 475-T23. x 12.



KERN & ANDREWS—AMERICAN CARBONIFEROUS FLORAS. IX

THE GALLATIN FOSSIL FOREST

HENRY N. ANDREWS AND LEE W. LENZ

The petrified forests of Yellowstone National Park have been a source of wonder ever since the early explorations of Jim Bridger, and that wonder grew into a more realistic admiration of geologic time and the forces that preserve plants through the ages following the studies of Dr. F. H. Knowlton during the latter years of the last century. In spite of the fact that some of the plant names in Knowlton's monograph would probably meet with revision in the hands of a present-day paleobotanist of Tertiary floras, it is likely that it will always stand as a classic in the annals of the science. It brought to light a flora, or more correctly a series of floras, strikingly different from the one that exists there to-day, and it made generally known the most spectacular of all petrified forests.

Fossil forests representing diverse ages in the earth's history, various modes of preservation, and a wide range of plant groups have been acclaimed by numerous authors. Perhaps the best known of all are the petrified trees of Arizona, although there the wood is, for the most part, too highly replaced to be of botanical value, and the great trees were transported some distance from their original habitat prior to petrification. Certainly among the most unique fossil floras, from the standpoint of the plants themselves, is the Devonian *Eospermatopteris* deposit near Gilboa, New York, and the Jurassic Cycad forest of the Black Hills. Unfortunately there is but little to be seen of these in the field. Through the work of the New York State Museum the "Dawn-seed-ferns" of Gilboa have been made to live again in an admirably executed restoration, and one may catch a glimpse of one of the earliest forests that existed on the earth. And we may be consoled in the knowledge that a large and representative series of the Dakota Cycads rests in security through the vigorous collecting activities of Professor Wieland. The same author has also given us a picture of the great Patagonian forest, especially remarkable for the prodigious abundance of petrified Araucarian cones that it has yielded.

In the coal balls and shales of the Carboniferous there is ample evidence of the Pteridophytic and early seed-plant forests that once covered so much of the globe, while occasionally, as with the Lycopod stumps preserved in Victoria Park, Glasgow, we see fragments of the forests in place. Another remarkable forest, preserved in a more precise sense of the word, is the one at Florissant, Colorado. Here a profusion of foliar remains, along with occasional representatives of the animal population, are preserved in volcanic ash beds immediately surrounding the stumps which were petrified in their original position in life. This is a rarely enough encountered combination of the trees and foliage that they bore. The impressions have been treated by a number of authors and are deserving of a comprehensive revision.

The discovery, in some abundance, of the silicified trunks of the Cretaceous *Tempskya* tree ferns in various of the northwestern states, and especially Idaho, has revealed a widespread and unique forest tree. But, like the Arizona petrifactions and numerous other western fossil wood deposits, these are not found in their original place of growth and hardly deserving of the term "fossil forest."

All of these forest remains of the past are important and distinctive in their own way and the age that they represent. Yet none of them can vie with the immense grandeur in both space and time of the Yellowstone forests. Nowhere else does there exist the succession of one forest directly above the grave of its predecessor—a succession that emphasizes perhaps more forcefully than any other plant fossil deposit the immensity of geologic time. Individually these forests attained ages well exceeding 1,000 years, and there is a minimum of no less than 16 of them extending one above the other.

The petrified forests in the Specimen Ridge region south of the Lamar River, being not far distant from the main stream of travel through the Park, are rather well known. It is the purpose of this article to focus some attention on the fine display of fossil forests in the extreme northwest corner of the Park. Although this is a region that is by no means unknown, it is certainly worth more attention than it has received from botanists and geologists, whether amateur or professional.

There is a fine camp ground about 300 yards up Specimen Creek from the Gallatin Canyon highway (Route U. S. 191), and shortly to the north there is noted a "Fossil Forest" on the U. S. Geological Survey's map of the Park. From our own observations the finest exposure of the forests is found about two miles northeast of this point considerably closer to the summit of Big Horn Peak. While it is quite possible to make the climb, see a good deal of the forests, and return to the camp ground on the same day, a two-day trip allows a more leisurely and profitable study.

An excellent trail leaves the highway and follows along the north side of Specimen Creek. Two unnamed tributaries may be noted on the topographic map flowing in from the north, the second of which departs from Specimen Creek about one and three-quarters miles from the camp ground. About a quarter of a mile north of the trail this divides into two branches which, for the sake of clarity, may be referred to as the West Fork and East Fork, although no names are designated on the map. On our trip of last summer we packed in provisions for overnight and set up camp about 200 yards north of the point where the two forks join.

The finest succession of fossil forests that were encountered occur on the southwest slope of the spur on either side of which the two forks flow. In ascending this spur petrified stumps were found at about the 8,000-foot contour, and splendid displays of at least ten successive forests were counted extending up the rocky exposed southwest face of the spur.

It is well to emphasize that figures given here are only approximate inasmuch as surveying instruments were not employed, and the number of forests given is a very conservative minimum. A "forest" was recorded only where a series of at

Upper: A petrified stump of *Sequoia magnifica* Knowlton, 14 feet in diameter.
Lower: A portion of the Gallatin fossil forest showing silicified stumps at three successive forest levels.

Upper: An exceptionally tall specimen in the Gallatin fossil forest. Most of the trees weather to within a few feet of the surrounding breccias.

Lower: Two stumps showing roots intact.

least four or five stumps could be traced along the same horizon, or where rooted specimens were observed. A more precise counting of the forests was hampered by two factors—the cover of modern vegetation on the lower slopes of the spur as well as the upper reaches on and immediately below the ridge, and the nearly precipitous nature of the terrain above the uppermost reaches of the West Fork, as is clearly indicated on the topographic sheet of the Park.

Modern vegetation covers the volcanics at about the 8,500-foot contour of the spur, and it is necessary to follow along in a westerly direction almost to the Left Fork. The breccias are well exposed in the stream bed and its immediate vicinity and above its uppermost limit for another 500 feet or more. Here six more forests were defined at less regular intervals. It is almost certain that the actual number preserved here must be at least twice that recorded, but due to the steepness of the slope most of the stumps do not remain long in position once they start to weather out.

The average vertical distance between the ten successive forests that were counted on the spur slope was about 25 feet, with a variation of about 15 to 35 feet. To determine the distance more exactly between forests would require leveling instruments and considerable excavation inasmuch as only occasionally are the stumps exposed to the roots. Since the area is most unique and a National Park as well, the latter treatment would hardly be justified. Thus, while evidences of sixteen successive eras of forest growth were found on the spur and the upper reaches of the Left Fork ravine it seems safe to suggest that half again that number would be revealed by more detailed study. Such evidence is hardly required to emphasize the spectacular nature of the forests.

On the second day we ascended the spur that lies between the two previously mentioned tributaries of Specimen Creek. The fossil forests are first met at a somewhat higher level here partly because the living vegetation cover extends up higher, and partly because the beds dip toward the southeast. Following this spur to about the 8,300-foot contour one may then traverse about 100 yards to the west into an exceedingly rugged ravine where numerous stumps are exposed through a vertical distance of some few hundreds of feet. The successive forests cannot be traced as clearly in this sector although it is of interest for the large size of some of the stumps, a Sequoia 14 feet in diameter being the largest that we encountered. Although a central core some 5 feet in diameter had been destroyed in this tree prior to fossilization a study of wood specimens from the remaining part of the trunk showed an average of 19 rings to the inch, indicating an age of about 1,600 years for the tree.

Unfortunately there were few evidences of well-preserved foliar remains in the territory that was covered. The forests do extend for some distance to the northwest, however, and it is possible that leaf impressions might be found at other points. If such were located the possibility of an ecological study is evident and should produce most interesting results. Aside from this the region is well worth a day's time for any naturalist with a paleontological bent.

FLORA OF PANAMA

BY

ROBERT E. WOODSON, Jr.

AND

ROBERT W. SCHERY

AND COLLABORATORS

PART III

Fascicle 3

ORCHIDACEAE (Williams)
(second part)

Annals
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FLORA OF PANAMA

Part III. Fascicle 3

ORCHIDACEAE

By LOUIS O. WILLIAMS

27. EPIDENDRUM L.

EPIDENDRUM L. Sp. Pl. ed. 2. 1347. 1763; Ames, Hubbard & Schweinfurth, Genus Epidendrum in U. S. & Middle America, pp. 1–233. 1936. Non L. Sp. Pl. ed 1. 952. 1753.—Conserved name, the generic type being *Epidendrum nocturnum* Jacq.

Amphiglottis Salisb. in Trans. Hort. Soc. Lond.1:294. 1812, nomen nudum.
Auliza Salisb. loc. cit., nomen nudum.
Dinema Lindl. Collect. Bot., App. 1825, nomen subnudum.
Encyclia Hook. in Bot. Mag. 55: *t. 2831.* 1828.
Nanodes Lindl. in Bot. Reg. 18: *t. 1541.* 1832.
Physinga Lindl. in Bot. Reg. 24: Misc. p. 32. 1838.
Barkeria Knowl. & Westc. Fl. Cab. 2:7, *t. 49.* 1838.
Hormidium Lindl. ex Heynhold, Nomencl. Bot. Hort. Nachtr. 880. 1841.
Spathiger Small, Fl. Miami, p. 55. 1913.
Dimerandra Schltr. in Fedde Rep. Sp. Nov. Beih. 17:43. 1922.

Small to large, epiphytic or semi-epiphytic herbs or subshrubs with or without the stems swollen into pseudobulbs. Stems (secondary) swollen into pseudobulbs and the leaves borne at or near the apex of the pseudobulbs (§ ENCYCLIUM); or the stems slender and not swollen and with the leaves scattered along the stem (§ EUEPIDENDRUM); or slender or fusiform stems with the leaves scattered along them but with the base of the stems swollen (§ BARKERIA). Leaves variable in shape and size, usually coriaceous but occasionally fleshy. Inflorescence commonly terminal but occasionally lateral or both terminal and lateral, rarely borne from lateral, leafless shoots which later develop into pseudobulbs or stems; from simple and often 1-flowered to compound and many-flowered. Flowers from small to relatively large. Sepals equal or subequal, spreading, reflexed or subconnivent. Petals similar to the sepals but usually smaller and narrower or even filiform, occasionally broader. Lip unguiculate; the claw free, partially free, or adnate to the column; lamina simple or 3-lobed, the lobes often lobulate; the disc ecallous or usually bicallous and with or without lamellae or additional calluses. Column stout or slender, alate or exalate, clinandrium variously developed. Anther terminal, operculate, incumbent, 2-celled and with each cell more or less divided by a septum; pollinia 4, uniseriate, laterally compressed, with appendages, rarely without, waxy. Capsule various, winged or wingless.

Issued December 7, 1946.

Epidendrum is the largest genus of neotropical orchids. It contains about one thousand species. Certain species are exceedingly abundant in their range and in places might almost be called weeds.

The most recent study of this vast genus is Ames, Hubbard, and Schweinfurth's admirable monograph, cited above. We are much indebted to the authors of the fine key in that work, which has been followed as closely as possible in the following key to the Panamanian species. We are particularly indebted to Mr. Charles Schweinfurth for suggestions and criticism during its preparation, and to Prof. Oakes Ames for his generous permission to use many of the illustrations.

a. Stems with true pseudobulbs surrounded by scarious non-leaf-bearing sheaths or occasionally leaf-bearing sheaths; leaves 1 or more borne at or near the summit of the pseudobulbs; lip free from the column or variously adnate to it........Sect. I. ENCYCLIUM (p. 322)
aa. Stems lacking true pseudobulbs although sometimes thickened; leaves distributed along the stem or at least leaf-sheaths surrounding the thickened bases of the stem.
  b. Lip free from the column or adnate only at the base; the column usually winged; the stems swollen at the base or fusiform-cylindric ....Sect. II. BARKERIA (p. 338)
  bb. Lip usually adnate to the entire length of the column (occasionally less); the column not winged laterally; stem never swollen....Sect. III. EUEPIDENDRUM (p. 338)

Sect. I. ENCYCLIUM

a. Lip entire or at most obscurely lobulate.
  b. Pseudobulbs 1-leaved.
    c. Lip ligulate or pandurate, slightly broader toward the apex.
      d. Ovary muricate; sepals more than 10 mm. long........ 3. E. BOOTHII
      dd. Ovary smooth; sepals less than 10 mm. long........ 13. E. OTTONIS
    cc. Lip ovate to suborbicular-cordate.
      d. Leaves narrowly linear........20. E. STANGEANUM
      dd. Leaves ligulate to oblong-elliptic.
        e. Lip hastate-rotund, acute; sepals oblong-lanceolate........18. E. SPONDIADUM
        ee. Lip ovate to ovate-subrotund, acuminate; sepals linear-lanceolate........10. E. FRAGRANS
  bb. Pseudobulbs 2- or more leaved.
    c. Inflorescence abbreviated; peduncle short or wanting........ 1. E. ABBREVIATUM
    cc. Inflorescence not abbreviated; peduncle more or less elongated.
      d. Lamina of the lip noticeably longer than broad.
        e. Apex of the lip rounded, obtuse, truncate or retuse [Species reported in cultivation]........ 80. E. LIVIDUM
        ee. Apex of the lip acute or acuminate........ 4. E. BRASSAVOLAE
      dd. Lamina of the lip as broad as long or broader than long.
        e. Bracts of the inflorescence conduplicate and clasping the pedicel, conspicuous; rachis flexuose; pseudobulb stipitate......22. E. VOLUTUM
        ee. Bracts of the inflorescence concave to flat; rachis straight or inconspicuously flexuose.
          f. Callus of the lip a simple or bilobed cushion.
            g. Disc of the lip occupied by a central bilobed cushion-like callus; sepals and petals usually maculate........ 9. E. CRASSILABIUM
            gg. Disc of the lip with a simple, basal, velutinous cushion-like callus; sepals and petals not maculate........11. E. IONOPHLEBIUM
          ff. Callus of the lip consisting of 2 or 3 basal keels or swellings........ 7. E. COCHLEATUM
aa. Lip 3-lobed or 3-lobulate.
  b. Column with a distinct lateral auricle on each side about opposite the stigma.
    c. Column more or less sharply recurved in the middle; veins of the mid-lobe of the lip smooth or nearly so........12. E. ONCIDIOIDES var. RAMONENSE

cc. Column straight or nearly so; veins on the mid-lobe of lip often verruculose.
d. Lateral lobes of the lip triangular-lanceolate to oblong............12a. E. ONCIDIOIDES var. GRAVIDUM
dd. Lateral lobes of the lip spatulate or oblong-spatulate..................12b. E. ONCIDIOIDES var. MOOREANUM
bb. Column lacking distinct lateral auricles on either side of the stigma.
c. Mid-lobe of lip proportionally narrower at base, linear-elongate or linear-filiform.
d. Lateral lobes of lip fimbriate-ciliate.. 6. E. CILIARE
dd. Lateral lobes of lip entire to somewhat dentate..........................14. E. PARKINSONIANUM
cc. Mid-lobe of lip proportionally broader at base, not linear-elongate or linear-filiform.
d. Outer margins of mid-lobe of lip dentate to fimbriate..............19. E. STAMFORDIANUM
dd. Outer margins of mid-lobe of lip not dentate to fimbriate.
e. Mid-lobe of the lip smaller than either lateral lobe or about equal to either of them.
f. Floral bracts conspicuous, 14 mm. long or more.
g. Lip 3-lobate; mid-lobe about as broad as long..................22. E. VOLUTUM
gg. Lip deeply 3-partite; mid-lobe oblanceolate, longer than broad.. 6a. E. CILIARE var. OERSTEDII
ff. Floral bracts not very conspicuous, 10 mm. or less long.
g. Mid-lobe of the lip triangular...16. E. PYGMAEUM
gg. Mid-lobe of the lip not triangular.
h. Petals less than one-half as broad as the lateral sepals; inflorescence commonly basal..17. E. ROUSSEAUAE
hh. Petals at most only slightly narrower than the sepals; inflorescence terminal.. 9. E. CRASSILABIUM
ee. Mid-lobe of the lip considerably larger than each lateral lobe.
f. Pseudobulbs 1-leaved.
g. Base of the lip gradually narrowed below the lateral lobes; floral bracts large, chartaceous................................ 5. E. CAMPYLOSTALIX
gg. Base of the lip abruptly contracted below the lateral lobes; floral bracts small...12a. E. ONCIDIOIDES var. GRAVIDUM
ff. Pseudobulbs 2- or more leaved.
g. Pseudobulb contracted into a caulescent neck, 4–10 cm. long, separating the leaves from the swollen portion...... 21. E. VARICOSUM
gg. Pseudobulb not contracted into a caulescent neck, leaves almost sessile on the swollen portion.
h. Mid-lobe of lip trulliform, acuminate......................... 15. E. PRISMATOCARPUM
hh. Mid-lobe of lip not trulliform nor acuminate.
i. Middle clinandrial tooth at summit of column broad, erect, fleshy and quadrate or orbicular-quadrate, distinct from lateral teeth...................................... 8. E. CONDYLOCHILUM
ii. Middle clinandrial tooth at summit of column small, deltoid, incurved, obtuse or acute, separated from lateral teeth by a shallow sinus.
j. Area of mid-lobe of lip about 4–10 times that of either lateral lobe, usually retuse or bilobed.
k. Margin of mid-lobe of lip entire to erose-crenulate.. 2. E. ATROPURPUREUM
kk. Margin of mid-lobe of lip dentate-lacerate...... 2a. E. ATROPURPUREUM var. LACINIATUM
jj. Area of mid-lobe of lip about 3 times that of either lateral lobe, or less.
k. Column somewhat sharply recurved in the middle; veins of mid-lobe usually smooth........ 12a. E. ONCIDIOIDES var. RAMONENSE
kk. Column nearly straight; veins of mid-lobe of lip often verruculose.
l. Lateral lobes of lip spatulate to oblong.......... 12b. E. ONCIDIOIDES var. MOOREANUM
ll. Lateral lobes of lip deltoid-lanceolate to oblong.. 12a. E. ONCIDIOIDES var. GRAVIDUM

Sect. II. Barkeria

One species in Panama.......23. E. stenopetalum

Sect. III. Euepidendrum

a. Leaves equitant.
b. Flowers long-pedunculate and terminal.......43. E. equitantifolium
bb. Flowers sessile or nearly so and axillary.......50. E. lockhartioides
aa. Leaves not equitant.
b. Lip distinctly 3-lobed or 3-lobulate.
c. Leaves terete, or subterete and sulcate, or flat and ligulate-linear.
d. Mid-lobe of lip semicircular-triangular, apiculate.......65. E. pudicum
dd. Mid-lobe of lip elliptic to narrowly oblong, provided with a prominent lamellate callus.......75. E. teretifolium
cc. Leaves flat and usually more than 3 mm. broad.
d. Column with a distinct dorsal horn at the apex.......51. E. microdendron
dd. Column without a distinct dorsal horn at the apex.
e. Mid-lobe of lip narrowly triangular to linear, several times longer than broad.
f. Lateral lobes of the lip laciniate-fimbriate.......35. E. criniferum
ff. Lateral lobes of the lip not laciniate-fimbriate.
g. Inflorescence subtended by one or more large spathes.......54. E. obesum
gg. Inflorescence usually not subtended by spathes; if so then by small inconspicuous ones.......53. E. nocturnum
ee. Mid-lobe of the lip not narrowly triangular to linear.
f. Lip tubular-involute, usually fleshy, in outline triangular to ovate-triangular, longer than broad.......72. E. sculptum
ff. Lip not tubular-involute, usually flat.
g. Area of the mid-lobe of lip approximately twice that of either lateral lobe or even larger.
h. Outer surface of lateral sepals verrucose.......44. E. exasperatum
hh. Outer surface of the lateral sepals smooth.
i. Apex of mid-lobe of lip rounded or protuberant-acute.
j. Floral bracts large, cucullate, only slightly shorter than the flowers; inflorescence subcapitate with 1 flower appearing at a time.......41. E. ellipsophyllum
jj. Floral bracts small (or if large then much shorter than the flowers), not cucullate; inflorescence not subcapitate and normally with several flowers at a time.
k. Lateral lobes of the lip dentate to lacerate; inflorescence usually long-pedunculate.......47. E. imatophyllum
kk. Lateral lobes of the lip not dentate nor lacerate; inflorescence not long-pedunculate.
l. Lip spatulate, base of the mid-lobe broad and not unguiculate.......79. E. Warscewiczii
ll. Lip not spatulate, base of the mid-lobe with a narrowed or unguiculate base.......38. E. dentilobum
ii. Apex of the mid-lobe of the lip truncate, retuse or bilobed, sometimes apiculate.
j. Lateral lobes of lip digitate, lacerate or deeply dentate; sepals pink, not maculate.......27. E. caligarium
jj. Lateral lobes of the lip entire to minutely crenulate or crenate-dentate or bilobulate.
k. Leaves obtuse and minutely bilobed at the apex, usually ovate to elliptic or elliptic-lanceolate.
l. Inflorescence paniculate; sepals and petals maculate.......71. E. Schumannianum
ll. Inflorescence racemose; sepals and petals not maculate.......42. E. Endresii
kk. Leaves acute or acuminate, not bilobed at the apex, usually linear-lanceolate to lanceolate.
l. Lobules of the mid-lobe of lip several times larger than the dentiform lateral lobes; inflorescence usually subumbellate or subcorymbose.......29. E. centradenia

ll. Lobules of the mid-lobe of the lip about equalling in size the oblong or falcate-lanceolate lateral lobes, or smaller; inflorescence usually racemose ..... 30. E. CENTROPETALUM

gg. Area of mid-lobe of lip about equal to that of either lateral lobe or less.

h. Ovary with a saccate vesicle at the summit ..... 58. E. PHYSODES

hh. Ovary without a saccate vesicle at the summit.

i. Column, when seen from the side, like an ox-bow ..... 39. E. DIFFORME

ii. Column, when seen from the side, not like an ox-bow, at most somewhat arched.

j. Inflorescence 1-flowered or subumbellate.

k. Sepals narrowly lanceolate, long-acuminate; stems usually straight or nearly so; usually but 1 flower open at a time ..... 40. E. EBURNEUM

kk. Sepals broadly lanceolate to oblanceolate or obovate-oblong; stems flexuose.

l. Sepals more than 1 cm. broad; inflorescence, as far as known, 1-flowered ..... 57. E. PENDENS

ll. Sepals less than 0.8 cm. broad; inflorescence usually more than 1-flowered.

m. Mid-lobe of lip, when present, twice or more broader than long, semi-elliptic to reniform ..... 39. E. DIFFORME

mm. Mid-lobe of lip usually little broader than long; if as broad, subquadrate to subquadrate-ovate.

n. Apex of the mid-lobe truncate, retuse or somewhat bilobed, usually apiculate ..... 39a. E. DIFFORME var. FIRMUM

nn. Apex of the mid-lobe of the lip triangular, acute ..... 39b. E. DIFFORME var. SIMULACRUM

jj. Inflorescence racemose or paniculate.

k. Mid-lobe of the lip not bilobed nor retuse.

l. Inflorescence a dense spike-like raceme which is more or less arcuate; leaves linear-lanceolate ..... 62. E. POWELLII

ll. Inflorescence not a dense spike-like raceme; leaves elliptic to lanceolate or oblanceolate.

m. Summit of column with a denticulate, sometimes 4-lobed wing ..... 40. E. EBURNEUM

mm. Summit of the column wingless.

n. Lip up to about 8.5 mm. broad; stems simple ..... 25. E. ANCEPS

nn. Lip 12 mm. or more broad; stems branched ..... 48. E. INCOMPTUM

kk. Mid-lobe of the lip bilobed or retuse.

l. Margins of lateral lobes of lips digitate, lacerate, or dentate.

m. Peduncle elongated, with close scarious tubular sheaths and with the flowers in dense racemes or sometimes paniculate; stems usually rooting opposite the leaves ..... 46. E. IBAGUENSE

mm. Peduncles not much elongated or if so the sheaths spreading, foliaceous or imbricated; stems not bearing roots opposite the leaves.

n. Mid-lobe of the lip with two strongly explanate lobules ..... 56. E. PANICULATUM

nn. Mid-lobe of the lip with the lobules more or less porrect, never strongly explanate.

o. Lateral sepals 7–16 mm. long ..... 60. E. POLYANTHUM

oo. Lateral sepals 4–6.5 mm. long ..... 60a. E. POLYANTHUM var. MYODES

ll. Margins of lateral lobes of lip not digitate, lacerate, nor dentate, sometimes crenate, undulate, or asymmetrically bilobed.
m. Spread between the tips of the divaricate lobules of the mid-lobe of the lip about twice or more greater than the length of the lobes........74. E. SUBNUTANS
mm. Spread between the tips of the more or less porrect lobules of the mid-lobe of lip or breadth of the mid-lobe less than twice the length.
n. Lip 2 cm. or more broad; raceme usually elongated and more than 6 cm. in diameter........52. E. MOYOBAMBAE
nn. Lip 1.5 cm. or less broad.
o. Pair of basal calluses of the lip absent; peduncle usually elongated........25. E. ANCEPS
oo. Pair of basal calluses of the lip present.
p. Peduncle conspicuously winged and ancipitous........24. E. ALLENII
pp. Peduncle not winged and ancipitous.
q. Lateral sepals 6.5–16 mm. long....60. E. POLYANTHUM
qq. Lateral sepals 4–6.5 mm. long....60a. E. POLYANTHUM var. MYODES
bb. Lip simple, obscurely lobate or bilobed.
c. Lower portion of lateral margins of lip irregularly lacerate to coarsely dentate; lamina with a prominent central keel extending almost to the apex........47. E. IMATOPHYLLUM
cc. Lower portion of lateral margins of lip neither lacerate nor coarsely dentate.
d. Leaf-blade not articulated to the sheath, thus not deciduous.
e. Plants elongated and creeping; lateral sepals without a keel on the outer surface........32. E. CONFERTUM
ee. Plants not elongated and creeping; lateral sepals keeled on the outer surface.
f. Lip cordate-ovate, acute; clinandrium entire or denticulate........33. E. CONGESTUM
ff. Lip reniform-suborbicular, apiculate; clinandrium lacerate......70. E. SCHLECHTERIANUM
dd. Leaf-blade articulated to the sheath, thus deciduous.
e. Ovary with a more or less semiglobose vesicle at the summit just under the lip.
f. Anterior portion of the lamina of lip broadly rounded.
g. Leaves triangular-lanceolate or narrower, scattered along the stem; lip not strongly conduplicate........58. E. PHYSODES
gg. Leaves elliptic to elliptic-oblong, congested on the upper part of the stem; lip strongly conduplicate........28. E. CAROLII
ff. Anterior portion of the lamina of the lip acute or acuminate........73. E. STROBILIFERUM
ee. Ovary without a semiglobose vesicle at the summit.
f. Back of the column terminating in a distinct, more or less spreading horn........51. E. MICRODENDRON
ff. Back of the column not terminating in a distinct spreading horn.
g. Lip with a tridentate (not tricarinate) or V-shaped callus at or near the base of the lamina.
h. Leaves usually sulcate, terete or subterete, if flattened then very narrowly linear-lanceolate, often grass-like and acuminate........49. E. ISOMERUM
hh. Leaves flat or at most conduplicate, ligulate or linear-oblong to lorate, or lanceolate to nearly elliptic, obtuse, bilobate.
i. Lamina of the lip suborbicular-cordate, commonly broader than long........59. E. PLATYSTIGMA

ii. Lamina of the lip triangular to ovate-triangular, usually longer than broad.
j. Margins of the lip very fleshy and thickened........ 69. E. SANCHOII
jj. Margins of the lip not fleshy and thickened.
k. Stems slender, usually 4 mm. or less in diameter below the inflorescence; leaf-sheaths and bracts not maculate; inflorescence usually lax and narrow........ 66. E. RAMOSUM
kk. Stems thicker, usually 5–6 mm. in diameter just below the inflorescence; leaf-sheaths and bracts usually finely maculate; inflorescence typically rather congested and broad........ 66a. E. RAMOSUM var. ANGUSTIFOLIUM
gg. Lip never with a tridentate or V-shaped callus at or near the base of the lamina.
h. Lamina of the lip triangular with a truncate base; inflorescence 1-flowered........ 78. E. TRIANGULABIUM
hh. Lamina of the lip never triangular with a truncate base.
i. Entire length of column adnate to base of lateral sepals........ 61. E. PORPAX
ii. Entire length of column not adnate to the base of the lateral sepals.
j. Stems branched.
k. Lip callus-bearing.
l. Clinandrium lacerate-dentate; lateral sepals falcate and acuminate; plant dwarf........ 37. E. DENTIFERUM
ll. Clinandrium not lacerate-dentate; lateral sepals not falcate.
m. Floral bracts very conspicuous, large and broad........ 31. E. COCLÉENSE
mm. Floral bracts not conspicuous, small and usually narrow.
n. Disc of lip bearing more or less lobate or retuse calluses, usually situated well above the base........ 77. E. TRACHYTHECE
nn. Disc of the lip not bearing more or less lobate or retuse calluses.
o. Clinandrium with 4 subrectangular petaloid lobes, the central pair longest and narrowest........ 76. E. TETRACEROS
oo. Clinandrium lacking 4 lobes........ 26. E. BISULCATUM
kk. Lip ecallose (mid-nerve sometimes thickened).
l. Inflorescence 1-flowered........ 67. E. REPENS
ll. Inflorescence 2- or more flowered.
m. Leaves less than 1 cm. broad, linear to linear-oblong........ 69. E. SANCHOII
mm. Leaves more than 1 cm. broad, elliptic to elliptic-ovate........ 36. E. CRYPTANTHUM
jj. Stems unbranched.
k. Floral bracts conspicuous due to their size compared to the flower, or to their distinct spreading character.
l. Lamina of the lip broader than long, reniform, bilobed or retuse........ 34. E. CORIIFOLIUM
ll. Lamina of the lip longer than broad or at most very slightly broader than long.
m. Flowers clustered at the end of a long naked peduncle.
n. Peduncle conspicuously winged and ancipitous........ 24. E. ALLENII
nn. Peduncle not conspicuously winged and ancipitous........ 55. E. PANAMENSE
mm. Flowers not clustered at the end of a long naked peduncle.
n. Lamina of the lip cordate-orbicular, about as long as broad........ 68. E. RIGIDUM

nn. Lamina of the lip oblong-ovate, longer than broad........ 68a. E. RIGIDUM var. ANGUSTISEGMENTUM

kk. Floral bracts not conspicuous.
l. Inflorescence 1-flowered or subumbellate.
m. Lateral sepals narrowly lanceolate, long-acuminate; leaf-sheaths not dilated toward their summits; usually 1 flower open at a time; lip white........ 40. E. EBURNEUM
mm. Lateral sepals broadly lanceolate or oblanceolate to elliptic-oblong or ovate-oblong; leaf-sheaths dilated toward their summits.
n. Leaves semiterete and sulcate, linear-oblong........ 65. E. PUDICUM
nn. Leaves flat or conduplicate, usually ligulate to elliptic.
o. Leaf-sheaths strongly cuneate (viewed laterally), large and flaring, the folded sheath 2 cm. broad at junction with leaf; leaves strongly conduplicate, 2 cm. broad when folded........ 45. E. HUNTERIANUM
oo. Leaf-sheaths not broadly flaring, the folded sheaths less than 1 cm. broad at junction with the leaf; leaves more or less flat, usually not strongly conduplicate, when so, less than 1 cm. broad when folded.
p. Lamina of the lip distinctly broader than long, reniform to transversely oval........ 39. E. DIFFORME
pp. Lamina of the lip about as broad as long, suborbicular-cordate........ 39b. E. DIFFORME var. SIMULACRUM
ll. Inflorescence racemose or paniculate, mostly 3- or more flowered.
m. Lateral sepals 22 mm. or more long.
n. Lateral sepals narrowly lanceolate, long-acuminate; lip subentire, white........ 40. E. EBURNEUM
nn. Lateral sepals narrowly spatulate-oblanceolate, acute or obtuse; lip denticulate or crenate-dentate, orange-vermillion........ 64. E. PSEUDEPIDENDRUM
mm. Lateral sepals 16 mm. or less long.
n. Lip conduplicate; peduncle elongated; raceme elongated and narrow.
o. Apex of the lip broadly rounded and retuse-apiculate; lateral sepals with a dorsal keel toward the apex........ 28. E. CAROLII
oo. Apex of the lip short-acuminate; lateral sepals without a dorsal keel........ 63. E. PROBIFLORUM
nn. Lip not conduplicate, flat or at most somewhat convex........ 25. E. ANCEPS

Sect. I. ENCYCLIUM

1. EPIDENDRUM ABBREVIATUM Schltr. in Fedde Rep. Sp. Nov. 3:107. 1906.
Epidendrum prorepens Ames, Sched. Orch. 2:33. 1923.

Small, repent, epiphytic herbs up to 2.5 dm. tall. Pseudobulbs 3.5–10 cm. long and 0.3–1 cm. in diameter, fusiform, occasionally stipitate, normally bifoliate. Leaves 4–14 cm. long and 0.3–1.5 cm. broad, obtuse, ligulate, subcoriaceous. Inflorescence a short, 1- to 5-flowered raceme up to about 4 cm. long. Dorsal sepals 10–15 mm. long and 2.5–3.5 mm. broad, linear-oblanceolate, obtuse or acute,

often carinate dorsally along the midrib. Lateral sepals 10–15 mm. long and 3–4 mm. broad, linear-lanceolate, obtuse to acute. Lip unguiculate, the claw adnate to the column, free portion 7–10 mm. long and 5–8 mm. broad, ovate to oblong-ovate; disc with a conspicuous callus-thickening at the base.

Guatemala, Honduras, Costa Rica and Panama.

CHIRIQUÍ: Boquete District, alt. 1300 m., *Davidson 666;* "Chiriquí", alt. 1300 m., *Powell 152, 3560.* COCLÉ: vicinity of La Mesa, hills north of El Valle de Antón, alt. 1000 m., *Allen 2354.* VERAGUAS: Santa Fé, alt. 500 m., *Powell s. n.*

2. EPIDENDRUM ATROPURPUREUM Willd. Sp. Pl. 4:115. 1805; Ames, Hub. & Schweinf. Genus Epidendrum in U. S. & Mid. Am. 60. 1936.

Epidendrum auropurpureum Lindl. Gen. & Sp. Orch. Pl. 99. 1831.
Epidendrum macrochilum Hook. in Bot. Mag. 63: *t. 3534.* 1836.
Epidendrum macrochilum Hook. var. *roseum* Batem. Orch. Mex. & Guat. *t. 17.* 1839.
Encyclia atropurpurea Schltr. Orchideen, p. 208, *fig. 49.* 1914.
Encyclia atropurpurea var. *leucantha* Schltr. in Fedde Rep. Sp. Nov. Beih. 17:45. 1922.
Encyclia atropurpurea var. *rhodoglossa* Schltr. loc. cit.

Robust caespitose epiphytic herbs. Pseudobulbs 3–8 cm. long or more and 1.5–5 cm. in diameter, ovoid, 1- to 3-leaved, usually bifoliate. Leaves 8–35 cm. long and 1.5–3.5 cm. broad, elliptic-ligulate or ligulate, obtuse or acute, coriaceous. Inflorescence a simple few- to many-flowered raceme up to 6 dm. long. Dorsal sepal 2.5–3.5 cm. long and 0.4–1.2 cm. broad, oblanceolate, obtuse. Lateral sepals similar to the dorsal but usually arcuate. Petals 2.5–3 cm. long and 0.7–1 cm. broad, oblanceolate to obovate, unguiculate, obtuse or acutish. Lip 3–5 cm. long and 1.8–4 cm. broad, 3-lobed, free nearly to the base of the column; lateral lobes oblong, obtuse or acute, relatively small, enfolding the column; mid-lobe large, variable, oblong to obovate to suborbicular to flabellate, always more or less emarginate.

Mexico, Guatemala, Salvador, Nicaragua, Costa Rica, Panama, the West Indies and in South America.

PROVINCE NOT KNOWN: "Panama", *Sinclair.* CHIRIQUÍ: between El Boquete and Caldera, alt. 300–700 m., *Pittier 3331.* COCLÉ: Penonome, alt. 15–300 m., *Williams 440.* PANAMÁ: Río Tecúmen, north of Chepo road, *Hunter and Allen 851;* San Juan, "all parts of the Pacific side", foothills east of city, *Powell 80, 148, 149, 3196, 3226.*

The copy of the Plumier plate (ed. Burmann) depicting this, which I have seen, is really not satisfactory for absolute identification. Lindley (Gen. & Sp. Orch. Pl. 100. 1831) had seen a copy of Plumier's plate in Lambert's herbarium and characterizes that of Burmann as a "caricature."

2a. EPIDENDRUM ATROPURPUREUM Willd. var. LACINIATUM Ames, Hub. & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 3:63. 1935.

Margins of the mid-lobe of the lip lacerate-dentate and the lateral lobes somewhat smaller than in the species (a malformation?).

Panama.

PANAMÁ: foothills east of Panamá City, alt. sea-level, *Powell 287.*

3. EPIDENDRUM BOOTHII (Lindl.) L. Wms. in Ann. Missouri Bot. Gard. 26:282. 1939.

Maxillaria Boothii Lindl. in Bot. Reg. 24: Misc. p. 52. 1838.
Dinema paleaceum Lindl. loc. cit. 26: Misc. p. 51. 1840.
Epidendrum auritum Lindl. loc. cit. 29: Misc. p. 4. 1843.
Epidendrum paleaceum Reichb. f. in Beitr. Orch. Centr.-Am. 80. 1866; Reichb. f. in Saunders Ref. Bot. 2: *t. 87.* 1869.
Nidema Boothii Schltr. in Fedde Rep. Sp. Nov. Beih. 17:43. 1922.

Repent or subcaespitose epiphytic herbs up to about 3 dm. tall. Rhizome creeping. Pseudobulbs up to about 5 cm. long, cylindric, fusiform or narrowly ovoid, stipitate, unifoliate. Leaves (when mature) 5–22 cm. long and 0.4–1.2 cm. broad, linear-ligulate, obtuse or acute, coriaceous. Inflorescence a 1- to few-flowered raceme; flowers small; bracts mostly 2–3 cm. long, lanceolate, cucullate, paleaceous, relatively large. Dorsal sepal 12–17 mm. long and 3–4 mm. broad, narrowly lanceolate to lanceolate, acute. Lateral sepals 11–15 mm. long and 2–3 mm. broad, linear-lanceolate to lanceolate, acute or acuminate, arcuate. Petals 7–12 mm. long and 2–4.5 mm. broad, lanceolate to elliptic-ovate, acute or acuminate. Lip 8–11 mm. long and 2–3.5 mm. broad, oblong-oblanceolate, obtuse or acute, slightly constricted above the middle, fleshy, bicarinate toward the base; disc often verrucose toward the apex.

From Mexico to Panama, the West Indies and northern South America, mostly at low elevations.

BOCAS DEL TORO: Río Cricamola, alt. about 10–15 m., *Woodson, Allen & Seibert 1892;* Isla Colón, *Wedel 123;* vicinity of Chiriquí Lagoon, *Wedel 1989.*

A species of low altitudes, often taken to be a *Maxillaria.*

4. EPIDENDRUM BRASSAVOLAE Reichb. f. in Bot. Zeit. 10:729. 1852; Hook. f. in Bot. Mag. 93: *t. 5664.* 1867.

Repent or caespitose epiphytic herbs up to about 5 dm. tall. Pseudobulbs up to 22 cm. long, from cylindric to ovoid, 2-, rarely 3-foliate. Leaves 12–26 cm. long and 2–4.5 cm. broad, oblong-ligulate to narrowly ovate, obtuse, coriaceous. Inflorescence a simple few-flowered raceme, exceeding the leaves; sheath inconspicuous, up to 12 cm. long. Sepals 3.5–5 cm. long and 0.3–0.5 cm. broad, linear-lanceolate, acute or acuminate, spreading. Petals similar to the sepals but slightly narrower. Lip 3–4.5 cm. long and 0.7–1.5 cm. broad, cuneate to a narrow base and adnate to the column for nearly the length of the column, simple; lamina 2–3 cm. long and up to 1.5 cm. broad, lanceolate-ovate, acuminate; claw with 2 short lamellate calluses.

Mexico, Guatemala, Honduras, Costa Rica and Panama.

CHIRIQUÍ: "Chiriquí Vulcan", *Warscewicz.*

This, like many another of Warscewicz's collections, is said to have come from Chiriquí, but has not been collected there since.

5. EPIDENDRUM CAMPYLOSTALIX Reichb. f. in Bot. Zeit. 10:730. 1852; in Saunders Ref. Bot. 2: *t. 86.* 1869; Summerhayes in Bot. Mag. 154: *t. 9243.* 1928.
Encyclia campylostalix Schltr. in Fedde Rep. Sp. Nov. Beih. 17:45. 1922.

Caespitose epiphytic herbs up to about 4.5 dm. tall. Pseudobulbs 2–12 cm. long and 2–4.5 cm. broad, ancipitous, narrowly oblong to ovoid, unifoliate. Leaves 4–30 cm. long and 1.3–8 cm. broad, elliptic, acute, subcoriaceous. Inflorescence an erect, 1- to many-flowered raceme subtended by a paleaceous sheath 1–7.5 cm. long; floral bracts 0.8–4 cm. long, linear to linear-lanceolate, acute, cucullate, paleaceous. Sepals similar, 16–20 mm. long and 3–4.5 mm. broad, linear-lanceolate, acute, the laterals slightly arcuate. Petals 13–17 mm. long and 1.5–2.5 mm. broad, ensiform to narrowly linear-oblanceolate, acute. Lip 12.5–18 mm. long and 6–9 mm. broad, unguiculate, only slightly adnate to the column at the base, 3-lobed; claw narrow, comprising about half the length of the lip; terminal portion of lip subquadrate in outline; lateral lobes from small and rounded to oblong, obtuse; mid-lobe rounded to obovate, disc with an inconspicuous callus thickening or low raised lamellae. Ovary conspicuously 3-winged.

Costa Rica and Panama.

CHIRIQUÍ: forests around El Boquete, alt. 1000–1300 m., *Pittier 3047*; "Chiriquí", alt. 1600 m., *Powell 74*.

This species is variable in size, and many specimens appear depauperate.

6. EPIDENDRUM CILIARE L. Syst. Nat., ed. 10:1246. 1759; Lindl. in Bot. Reg. 10: *t. 784*. 1824.

Auliza ciliaris Salisb. in Trans. Hort. Soc. Lond. 1:294. 1812.
Epidendrum cuspidatum Lodd. Bot. Cab. 1: *t. 10*. 1816; Lindl. in Bot. Reg. 10: *t. 783*. 1824.
Epidendrum viscidum Lindl. in Bot. Reg. 26: Misc. p. 81. 1840.
Phaedrosanthus ciliaris O. Ktze. in Post & Ktze. Lex. Gen. Phan. 429. 1904.

Repent or caespitose epiphytic herbs up to about 5 dm. tall. Pseudobulbs 8–22 cm. long and 0.6–2.2 cm. in diameter, cylindric, fusiform or tapering to the base, 1- to 2(–3)-leaved. Leaves 8–28 cm. long and 2–8 cm. broad, oblong-lanceolate, elliptic-oblong to oval, obtuse, coriaceous. Inflorescence a few- to several-flowered raceme; bracts 3.5–6.5 cm. long and 0.6–1.5 cm. broad, lanceolate to oblanceolate, cucullate, pergameneous. Sepals 35–85 mm. long and 1.5–6 mm. broad, linear to linear-lanceolate or linear-oblanceolate, acute or acuminate. Petals 35–70 mm. long and 1.5–5 mm. broad, linear-lanceolate to linear-oblanceolate, acute or acuminate. Lip 4–8 cm. long, 3-lobed, the base adnate to the column; lamina 3–6 mm. long, with 2 short lamellate calluses at the apex of the column; lateral lobes about 1.5–2.5 mm. long, each essentially reniform in outline or obliquely lanceolate-ovate, deeply dentate or usually lacerate; mid-lobe linear-filiform, up to 6 cm. long. Column with the clinandrium dentate or sublacerate.

Widely distributed and common from Mexico to Panama, through the West Indies and in South America.

CHIRIQUÍ: around El Boquete, alt. 1000–1300 m., *Pittier 3048*. "PROVINCE OF VERAGUAS AND CHIRIQUÍ": alt. 910–1210 m., *Powell 100, 3406*.

A variable species but a distinctive one. Often in cultivation. A putative hybrid between *E. ciliare* and *E. Parkinsonianum* is recorded.

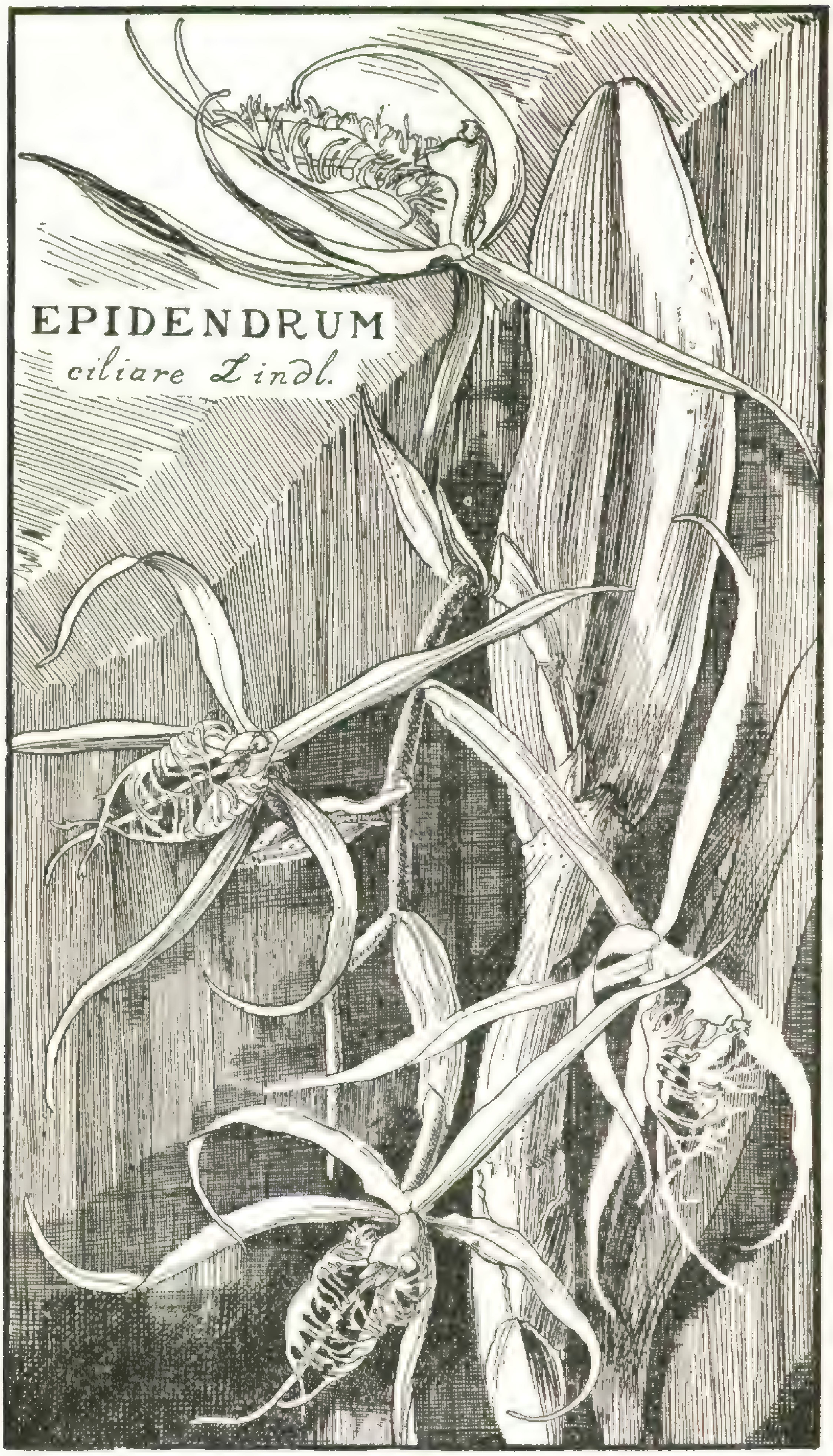

Fig. 120. *Epidendrum ciliare*

6a. EPIDENDRUM CILIARE L. var. **Oerstedii** (Reichb. f.) L. Wms. comb. nov.

Epidendrum Oerstedii Reichb. f. in Bot. Zeit. 10:937. 1852.
Epidendrum costaricense Reichb. f. loc. cit.
Epidendrum Umlaufii Zahlbr. in Wien. Illustr. Gartenzeit. 18:209, *t. 2.* 1893.

Similar to *E. ciliare* except the lateral lobes of the lip reniform, entire or at most crenulate, and the mid-lobe from filiform to broadly oblanceolate.

Costa Rica and Panama.

CHIRIQUÍ: Boquete, alt. 1150 m., *Davidson 738;* Palo Alto, alt. 1360 m., *Powell 239, 3325, 3339.*

Although this is obviously only a variation of *E. ciliare*, in which the lateral lobes of the lip are entire (or nearly so) and in which the mid-lobe is usually broader, its relationship seems not to have been suspected in recent years. Perhaps this is because of the very evident but superficial character of lacerate lateral lobes of the lip in *E. ciliare* and the entire (and thus less conspicuous) ones in the variety.

7. EPIDENDRUM COCHLEATUM L. Sp. Pl., ed. 2:1351. 1763; Ames, Hub. & Schweinf. Genus Epidendrum in U. S. & Mid. Am. 79. 1936.

Extremely variable epiphytic herbs up to about 5 dm. tall. Pseudobulbs 3–25 cm. long and 0.5–4 cm. broad, cylindric to fusiform to ovoid, round or flattened in cross-section, bifoliate or rarely otherwise. Leaves 10–35 cm. long and 2–5 cm. broad, elliptic to lanceolate to oblanceolate, acute. Inflorescence from shorter to longer than the leaves, a simple to branched raceme, subtended by a sheath which may be up to 15 cm. long. Flowers rather pretty, lip purple-marked to almost black, sepals and petals white to green, occasionally purplish. Sepals similar, 2.5–7 cm. long and 0.2–0.7 cm. broad, linear to linear-lanceolate, acute, usually strongly reflexed. Petals 1.5–5 cm. long and 0.15–0.4 cm. broad, narrowly linear, occasionally broadest near the apex, acute. Lip 1–3 cm. long and 1–2.5 cm. broad, short-unguiculate, claw adnate to the column for about half its length; lamina cordate-orbicular, usually broader than long, obtuse or apiculate, cochleate, with a more or less prominent callus thickening under the end of the column. Ovary 3-winged, prominently so in fruit.

Mexico to Venezuela and Colombia; the West Indies.

DARIÉN: Cana and vicinity, *Williams 974.*

A common and variable species, curiously known by only one collection in Panama.

8. EPIDENDRUM CONDYLOCHILUM Lehm. & Kränzlin in Engler's Bot. Jahrb. 26:459. 1899.

Epidendrum tessellatum Batem. in Bot. Reg. 24: Misc. p. 7. 1838, non Roxb.; Hook. in Bot. Mag. 65: *t. 3638.* 1838.
Epidendrum Deamii Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:402. 1918; Ames, Hub. & Schweinf. Genus Epidendrum in U. S. & Mid. Am. 88. 1936.
Encyclia tessalata Schltr. loc. cit. 474, sphalm.

Repent or caespitose epiphytic herbs up to about 4 dm. tall. Pseudobulbs 2–15 cm. long and 0.3–1.5 cm. in diameter, cylindric to usually fusiform or narrowly ovoid, bi- to trifoliate. Leaves 6–25 cm. long and 0.5–2.5 cm. broad, linear to elliptic, acute or obtuse, usually erect. Inflorescence usually shorter than the leaves, simple or rarely branched, few- to many-flowered. Flowers small, dull-colored, variable. Dorsal sepal 8–12 mm. long and 1.5–3 mm. broad, linear to linear-lanceolate, acute. Lateral sepals 8–13 mm. long and 2–3 mm. broad, lanceolate to lanceolate-ovate, acute. Petals 8–10 mm. long and 1.5–4 mm. broad, linear-oblanceolate to oblanceolate, obtuse. Lip 8–12 mm. long and 4–6 mm. broad, obovate, obovate-oblong to oval in general outline, distinctly 3-lobed to almost simple, free from the column, provided with a long low puberulent callus extending from the base to about the middle of the lip, and mammillate calluses from the middle toward the apex, these last often arranged in 3 rows; lateral lobes from very small to quite prominent and explanate, obtuse; mid-lobe with the margins undulate. Ovary winged.

Mexico, Guatemala, Honduras, Costa Rica, Panama, Venezuela and Colombia.

CHIRIQUÍ: "Chiriquí", alt. 1050–1450 m., *Powell 93, 95, 3345, 3350, 3351, 3359.*

This species has gone under the name of *Epidendrum Deamii* Schltr. for many years. It is perhaps not distinct from *E. lividum* Lindl., being separated by the presence of more or less distinct lateral lobes on the lip. The degree of lip lobation is of dubious value, for several specimens show almost entire lip, including typical material of *E. condylochilum.*

9. EPIDENDRUM CRASSILABIUM Poepp. & Endl. Nov. Gen. & Sp. Pl. 2:1, *t. 102.* 1838.

Epidendrum variegatum Hook. in Bot. Mag. 59: *t. 3151.* 1832.
Epidendrum baculibulbum Schltr. in Fedde Rep. Sp. Nov. Beih. 19:116. 1923.

Erect repent or caespitose epiphytes up to about 70 cm. tall. Pseudobulbs 15–35 cm. long and 0.5–1.5 cm. in diameter, cylindric (often thickened at the base) to fusiform, bearing 2–4 widely separated leaves. Leaves 14–40 cm. long and 2.5–4 cm. broad, elliptic to oblong-lanceolate, erect or spreading. Inflorescence a simple raceme either shorter or longer than the subtending leaf. Sepals similar, 10–13 mm. long and 0.3–0.6 mm. broad, oblong to ovate to obovate, obtuse. Petals 7–13 mm. long and 2.5–6 mm. broad, oblanceolate to oblong-oblanceolate, obtuse, oblique. Lip 7–8 mm. long and 4–6 mm. broad, short-unguiculate, only slightly longer than the column; claw short, adnate to the column at the base; lamina orbicular to ovate, acute or obtuse, provided with a longitudinal callus at the base which is usually a single raised ridge and at the apex divided into two lamellae extending almost to the apex of the lip.

Costa Rica, Panama, the West Indies and to Brazil.

COCLÉ: El Valle de Antón, *Allen 2205, Woodson & Schery 204.*

10. EPIDENDRUM FRAGRANS Sw. Nov. Gen. & Sp. Prodr. 123. 1788.

Epidendrum fragrans Sw. var. *pachypus* Schltr. in Fedde Rep. Sp. Nov. Beih. 17:32. 1922.

Repent or caespitose epiphytic herbs up to about 4 dm. tall. Pseudobulbs 4–11 cm. long and 0.5–3 cm. in diameter, variable, cylindric, cylindric-fusiform to ovoid, occasionally ancipitous, unifoliate. Leaves 8–30 cm. long and 1.5–5 cm. broad, ligulate to elliptic, obtuse, coriaceous. Inflorescence to 15 cm. long, shorter than the leaves, few- to several-flowered; sheaths up to 6 cm. long, chartaceous. Flowers greenish to yellowish, the lip usually lined with purple along the veins, sepals and petals rarely maculate. Sepals similar, 1.5–3.5 cm. long and 0.3–0.5 cm. broad, lanceolate or linear-lanceolate, acute or acuminate. Petals 2–3 cm. long and 0.5–1 cm. broad, broadly lanceolate to oblanceolate or obovate, acute or usually acuminate, unguiculate at the base. Lip 1.5–3 cm. long and 1–1.5 cm. broad, somewhat cochleate, base unguiculate and shortly adnate to the column; lamina ovate to ovate-subcordate, acuminate, provided with an inconspicuous callus at the base forming an inverted Y or with two small parallel calluses.

Mexico, Guatemala, Costa Rica, Panama, the West Indies and in South America to Brazil and Peru.

CANAL ZONE: *Maxon 4913;* San Juan and Frijoles, *Powell 30, 43, 3355, 3370, 3371, 3378, 3379, 3428, 3448, 3474;* Barro Colorado Island, *Shattuck 551.* COCLÉ: El Valle de Antón, *Allen 1678.*

11. EPIDENDRUM IONOPHLEBIUM Reichb. f. Beitr. Orch. Centr.-Am. 103. 1866.

Epidendrum pachycarpum Schltr. in Fedde Rep. Sp. Nov. 3:109. 1906.
Epidendrum Hoffmannii Schltr. loc. cit. 16:444. 1920.

Repent or caespitose epiphytic herbs up to about 4 dm. tall. Pseudobulbs 3–9 cm. long and 1.5–3 cm. broad, ovoid, rarely fusiform, bifoliate or rarely trifoliate. Leaves 10–35 cm. long and 1.5–4 cm. broad, ligulate or elliptic, obtuse. Inflorescence up to 15 cm. long, shorter than the leaves, few-to several-flowered. Flowers greenish to white with the lip more or less prominently lined with purple. Sepals similar, 1.4–3.5 cm. long and 0.3–0.8 cm. broad, lanceolate-ligulate to lanceolate, acute, the laterals somewhat oblique. Petals 1.2–2.4 cm. long and 0.4–0.9 cm. broad, elliptic-oblanceolate to oblanceolate, acute or acuminate. Lip 1.2–2.2 cm. long and 0.8–1.8 cm. broad, unguiculate; claw short, adnate to the column; lamina ovate to orbicular, obtuse or apiculate, cochleate, provided with an oblong-pandurate to quadrate, obscurely puberulent callus at the base under the apex of the column. Ovary angled, when mature alate.

In all Central American countries from Mexico to Panama and in Venezuela.

CANAL ZONE: near Frijoles, *Maxon 4724;* Culebra, alt. 50–100 m., *Pittier 3391;* San Juan, *Powell 187, 3182.* CHIRIQUÍ: Boquete District, alt. 1500 m., *Davidson 796;* "Chiriquí", *Powell 151, 187, 310, 3226, 3246, 3565.* VERAGUAS: San Francisco, alt. 300 m., *Powell 384.*

12. EPIDENDRUM ONCIDIOIDES Lindl. var. RAMONENSE (Reichb. f.) Ames, Hub. & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 3:103. 1935.

Epidendrum ramonense Reichb. f. Beitr. Orch. Centr.-Am. 81. 1866.
Encyclia ramonensis Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:473. 1918.
Encyclia Powellii Schltr. in Fedde Rep. Sp. Nov. Beih. 17:46. 1922.

Large caespitose epiphytic herbs up to about 1 m. tall. Rhizome short. Pseudobulbs up to about 10 cm. long, cylindric to usually ovoid, 2- to 4-foliate. Leaves 10–60 cm. long and 1–2.5 cm. broad, ligulate or ensiform, acute or obtuse. Inflorescence paniculate, exceeding the leaves, few- to many-flowered, simple or compound. Dorsal sepal 14–18 mm. long and 3.5–5 mm. broad, elliptic-lanceolate to oblong-lanceolate, acute or acuminate. Lateral sepals similar to the dorsal except somewhat arcuate. Petals 14–17 mm. long and 3–5.5 mm. broad, narrowly oblanceolate, acute or acuminate. Lip 12–15 mm. long; lateral lobes oblong, triangular-oblong, oblong-ovate or subquadrate-oblong, obtuse to truncate, arcuate; mid-lobe 7–10 mm. long and 6–8.5 mm. broad, ovate to suborbicular, obtuse to subacuminate; disc with 2 longitudinal fleshy ridges which form a fovea on the isthmus, extending onto the mid-lobe as thickened nerves. Column exauriculate, with terminal angles or with dentiform auricles.

Honduras, Costa Rica and Panama.

CHIRIQUÍ: "Chiriquí", alt. 1360–1510 m., *Powell 83*. COCLÉ: El Valle, alt. 1060 m., *Bouché 10*.

For all practical purposes this and the two following varieties might well be referred to *E. oncidioides* Lindl.

12a. EPIDENDRUM ONCIDIOIDES Lindl. var. GRAVIDUM (Lindl.) Ames, Hub. & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 3:104. 1935.

Epidendrum gravidum Lindl. in Jour. Hort. Soc. 4:114. 1849; Ames, Sched. Orch. 4:42, *t. 2.* 1923.
Encyclia gravida Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:472. 1918.
Epidendrum alanjense Ames, Sched. Orch. 1:13. 1922.
Encyclia Hunteriana Schltr. in Fedde Rep. Sp. Nov. Beih. 17:46. 1922.
Epidendrum amandum Ames, Sched. Orch. 4:36. 1923.
Epidendrum peraltense Ames, loc. cit. 46.

Similar to the preceding variety into which it intergrades, usually somewhat smaller in all parts. Mid-lobe of lip triangular-lanceolate to oblong. Veins of the mid-lobe verruculose.

Mexico, Honduras, Nicaragua, Costa Rica and Panama.

CHIRIQUÍ: Alanje, *Pittier s. n.*; David, *Powell 84, 3261, 3264, 3539, 3545*. PANAMÁ: San Juan Range, *Powell 271, 3479, 3485*.

12b. EPIDENDRUM ONCIDIOIDES Lindl. var. MOOREANUM (Rolfe) Ames, Hub. & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 3:106. 1935.

Epidendrum Mooreanum Rolfe in Kew Bull. 1891:199. 1891.
Encyclia Tonduziana Schltr. in Fedde Rep. Sp. Nov. Beih. 19:132. 1923.
Encyclia Brenesii Schltr., loc. cit. 221.

Much like the preceding variety. Lateral lobes of the lip spatulate or oblong-spatulate, veins verruculose.

Costa Rica and Panama.

CHIRIQUÍ: Volcán de Chiriquí, alt. 2120 m., *Davidson 879*; Lino Hill, alt. 1360 m., *Powell 292*.

Fig. 121. *Epidendrum oncidioides* var. *gravidum*

13. Epidendrum Ottonis Reichb. f. in Hamb. Gartenzeit. 14:213. 1858.

Nidema ottonis Britt. & Millsp. Bahama Fl. 94. 1920.
Nidema Boothii (Lindl.) Schltr. var. *triandrum* Schltr. in Fedde Rep. Sp. Nov. Beih. 17:43. 1922.

Small, repent or caespitose epiphytic herbs up to about 25 cm. tall. Rhizome creeping. Pseudobulbs up to about 4 cm. long, fusiform, short-stipitate, unifoliate. Leaves 5–19 cm. long and 0.5–0.9 cm. broad, linear-ligulate, obtuse or acute, coriaceous. Inflorescence a short, few-flowered raceme; flowers small, white or yellowish; bracts mostly 1–2 cm. long, lanceolate, acuminate, paleaceous. Dorsal sepal 7–9 mm. long and 2.5–3 mm. broad, elliptic-lanceolate, acute. Lateral sepals 7–9 mm. long and 2–2.5 mm. broad, lanceolate, acuminate, more or less arcuate. Petals 6–7 mm. long and 1.5–2 mm. broad, elliptic, elliptic-lanceolate to oblanceolate, acute or acuminate, arcuate. Lip 6.5–7 mm. long and about 1.5 mm. broad, narrowly oblong, acute, subpandurate, fleshy, canaliculate, keeled toward the apex below. Column monandrous or triandrous, if triandrous then the lateral stamens usually imperfect.

Panama, the West Indies, Venezuela, Colombia and Peru.

PANAMÁ: vicinity of Bejuco, *Allen 981*; east of Panamá City, *Powell 131, 3449*; swamp east of Tecúmen, *Standley 26611*; between Las Sabanas and Matías Hernández, *Standley 31888, 31945*.

Resembles *Epidendrum Boothii* (Lindl.) L. Wms. very much.

14. Epidendrum Parkinsonianum Hook. in Bot. Mag. 67: *t. 3778*. 1840.

Epidendrum aloifolium Batem. Orch. Mex. & Guat. *t. 25*. 1840, non L.
Epidendrum falcatum Lindl. var. *Zeledoniae* Schltr. in Fedde Rep. Sp. Nov. Beih. 19:37. 1923.

Repent epiphytic herbs up to about 6 dm. long. Stems creeping, branched, cylindric or somewhat swollen. Leaves 15–50 cm. long and 1–4.5 cm. broad, ligulate to lanceolate-ligulate, acute, very thick, more or less flaccid, occasionally pustulate, usually pendent. Inflorescence a very short, few-flowered raceme; bracts short, ovate; pedunculate ovaries up to about 16 cm. long. Sepals 5.5–9 cm. long and 0.6–1.2 cm. broad, linear-lanceolate to linear, acute or acuminate, spreading. Petals 5–8 cm. long, similar to the sepals. Lip 6–8.5 cm. long (from the base of the column) and 3–4 cm. broad, 3-lobed, the base adnate to the column; lateral lobes 2.5–4 cm. long, broadly lunate to oblong-lunate; mid-lobe 3–6 mm. long, linear.

Mexico, Guatemala, Honduras, Costa Rica and Panama.

CHIRIQUÍ: Pueblo del Volcán, alt. 1800–1960 m., *Gaines*; Upper Río Chiriquí Viejo, vicinity of Monte Lirio, alt. 1300–1900 m., *Seibert 214, 217*.

A curious species with large and handsome flowers. It is allied to *E. ciliare* and *E. pugioniforme* but is easily distinguished from them by the flaccid, differently shaped leaves.

15. EPIDENDRUM PRISMATOCARPUM Reichb. f. in Bot. Zeit. 10:729. 1852; Reichb. f. Xenia Orch. 2:83, *t. 123.* 1862; Hook. in Bot. Mag. 88: *t. 5336.* 1862.

Stout repent or caespitose epiphytic herbs up to about 5 dm. tall. Pseudobulbs up to about 15 cm. long and 5 cm. in diameter, narrowly ovoid, often attenuated above, bi–trifoliate, the leaves somewhat separated on the apex of the bulb. Leaves 12–33 cm. long and 2–6 cm. broad, variable, from ligulate and oblanceolate-oblong to narrowly ovate, obtuse, coriaceous. Inflorescence an erect, few- to many-flowered raceme. Dorsal sepals 22–44 mm. long and 3–5 mm. broad, narrowly lanceolate to narrowly oblanceolate, acute, arcuate. Petals 20–28 mm. long and 3–5 mm. broad, elliptic-linear to lanceolate, acute, arcuate. Lip 18–25 mm. long and 7–9 mm. broad, 3-lobed, free from the column nearly to the base, subsagittate, with a central callus from the base nearly to the apex; middle lobe large, trulliform, acuminate.

Costa Rica and Panama.

CHIRIQUÍ: "Province of Chiriquí", alt. 1200–1360 m., *Powell 99, 101, 3375, 3388, 3391, 3402;* "Chiriquí", *Warscewicz;* near El Volcán, *White 203;* Casita Alta to Cerro Copete, alt. 2300–3300 m., *Woodson & Schery 375.*

Allied to *E. brassavolae.* One of the commonest of the Epidendrums in cultivation in greenhouses. It is a good bloomer and grows well, the flowers occasionally being sold as cut flowers in the northern markets.

16. EPIDENDRUM PYGMAEUM Hook. in Bot. Mag. 60: *t. 3233.* 1833; Hook. Jour. Bot. 1:49, *t. 118.* 1834; Ames, Hub. & Schweinf. Genus Epidendrum in U. S. & Mid. Am. 160. 1936.

Hormidium pseudopygmaeum Finet in Bull. Herb. Boiss. 7:121, *t. 3.* 1899.

Small repent epiphytic herbs from a creeping rhizome. Pseudobulbs scattered along the rhizome, 2–10 cm. long, cylindric to fusiform, bifoliate. Leaves 2–15 cm. long and 0.7–2 cm. broad, narrowly elliptic to oblong-oval, obtuse to acute. Inflorescence sessile in the axils of the leaves, a short few- to several-flowered raceme. Flowers small, inconspicuous. Dorsal sepal 5–10 mm. long and 1.5–3 mm. broad, lanceolate, acuminate. Lateral sepals 6–12 mm. long and 2–4 mm. broad, lanceolate, acuminate, keeled dorsally toward the apex, shortly connate at the base and lightly adnate to the base of the column. Petals 4–8 mm. long and 0.5–1 mm. broad, linear, acute. Lip 3–8 mm. long and 3–7 mm. broad, clawed at the base and shortly adnate to the base of the column; lamina 3-lobed or 3-lobulate; lateral lobes explanate or erect, ovate to orbicular; mid-lobe small, apiculate. Ovary winged.

Florida and Mexico to Panama, the West Indies and to Brazil and Bolivia.

CHIRIQUÍ: vicinity of Monte Lirio, *Seibert 239.* COCLÉ: El Valle, *Seibert 426;* near El Volcán, *White 205.*

A variable and widely distributed species. There seem to be two forms of this,—one compact and small, the other rather loose and comparatively large. The second form is Finet's *Hormidium pseudopygmaeum.*

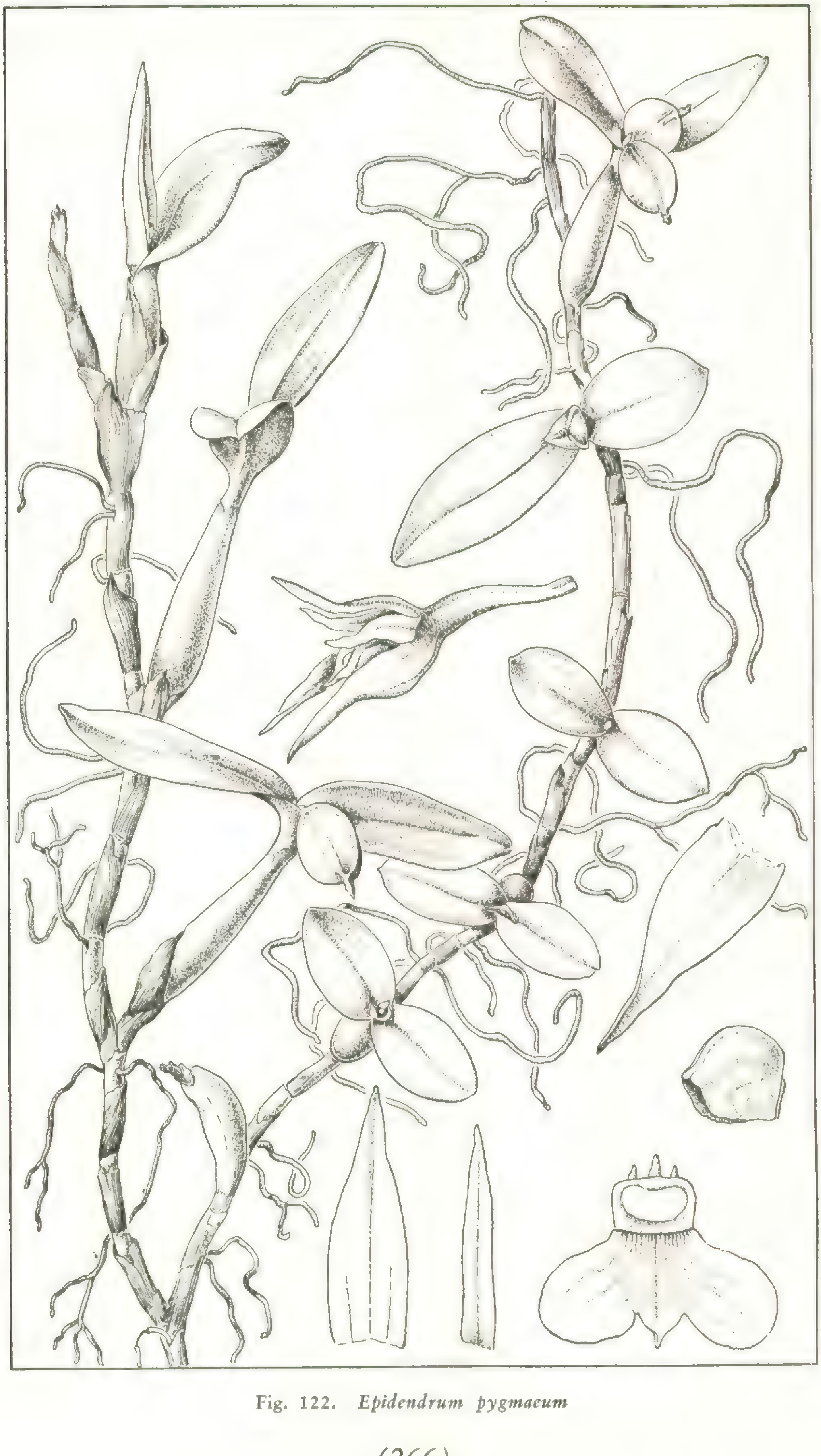

Fig. 122. *Epidendrum pygmaeum*

17. EPIDENDRUM ROUSSEAUAE Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:407. 1918; Ames, Hub. & Schweinf. Genus Epidendrum in U. S. & Mid. Am. 170. 1936.

Epiphytic herbs similar to *E. ramosum* Jacq. Leaves ligulate, about 7 cm. long and 1.2 cm. broad, obtuse. Inflorescence a lax several-flowered raceme up to about 10 cm. long. Flowers fleshy, greenish. Sepals about 1.2 cm. long, lanceolate-ligulate, acute, fleshy. Petals about 1.2 cm. long, linear or linear-oblanceolate. Lip unguiculate; claw adnate to the column; lamina about 7 mm. long and as broad, trilobate, provided with 2 parallel calluses extending from the base up to the base of the mid-lobe, base deeply cordate; lateral lobes spreading, dolabriform, obtuse; terminal lobe about 4 mm. long and 3.5 mm. broad, extended into a suborbicular blade from a broadly ligulate claw, obtuse, apiculate.

Panama.

CANAL ZONE: *Mrs. Rousseau, s. n.*

The description is taken from the original publication. Specimens are missing from the Ames Herbarium but Ames, Hubbard & Schweinfurth have cited the following collections from Panama: *Powell 112, 3393; Münch 27164; Shattuck 347.*

Curiously enough, Schlechter contrasts this species with *Epidendrum ramosum* Jacq., which belongs to the section EUEPIDENDRUM, while Ames, Hubbard anad Schweinfurth have placed it in the section ENCYCLIUM.

18. EPIDENDRUM SPONDIADUM Reichb. f. in Bot. Zeit. 10:731. 1852; Hook. f. in Bot. Mag. 119: *t. 7273.* 1893.

Epidendrum platycardium Schltr. in Fedde Rep. Sp. Nov. Beih. 17:36. 1922.

Repent or caespitose epiphytic herbs up to about 35 cm. tall. Pseudobulbs 3–12 cm. long and 0.6–1.3 cm. broad, cylindric to narrowly ovoid, unifoliate. Leaves 10–28 cm. long and 2.5–5 cm. broad, ensiform to elliptic, obtuse. Inflorescence shorter than the leaves, few-flowered; sheath about 2.5 cm. long. Flowers with sepals and petals greenish to white and the lip rose to purple. Sepals 13–20 mm. long and 3–6 mm. broad, lanceolate, acuminate or acute, the laterals oblique. Petals 12–17 mm. long and 3.5–6.5 mm. broad, lanceolate to lanceolate-ovate, acute or acuminate. Lip 12–15 mm. long and 10–12 mm. broad, short-unguiculate; claw adnate to the column; lamina suborbicular-reniform to cordate, apiculate, provided with a small subfoveate callus under the apex of the column which usually has 3 thickened nerves extending outward.

Costa Rica, Panama and possibly Jamaica.

CHIRIQUÍ: Palo Alto Hill, alt. 1500 m., *Powell 141.*

Very closely allied to *Epidendrum fragrans* Sw. and perhaps only a variation of that.

19. Epidendrum Stamfordianum Batem. Orch. Mex. & Guat. *t. 11.* 1838; Hook. in Bot. Mag. 80: *t. 4759.* 1854.

Epidendrum Cycnostalix Reichb. f. in Bot. Zeit. 10:731. 1852.

Caespitose epiphytic herbs up to about 50 cm. tall. Stems pseudobulbose, 8–27 cm. long and about 0.5–2 cm. in diameter, cylindric-fusiform to fusiform, bearing 1–4 leaves at or near the apex. Leaves 10–27 cm. long and 3–7 cm. broad, variable, ligulate, elliptic, oblong-lanceolate, or oblanceolate to oval, obtuse, coriaceous. Inflorescence up to about 60 cm. long, spreading or pendent, simple or paniculate, usually many-flowered, lateral from a short fertile shoot, or rarely terminal on the pseudobulb. Flowers rather pretty, fair-sized. Dorsal sepal 15–18 mm. long and 4–6 mm. broad, elliptic or lanceolate, acute or acuminate. Lateral sepals 14–18 mm. long and 4–6 mm. broad, lanceolate or oblong-lanceolate, strongly oblique, acute or acuminate. Petals 14–18 mm. long and 1.5–4.5 mm. broad, linear, elliptic, linear-oblong to lanceolate, acute. Lip unguiculate; claw adnate to the column; lamina 11–16 mm. long and 13–20 mm. broad, 3-lobed; lateral lobes large, spreading, oblong, oblique, obtuse, entire or crenulate; mid-lobe bilobulate, retuse, transversely oblong in outline, provided with a narrow, often cuneate claw at the base, entire or usually crenulate or serrulate; disc provided with a pair of parallel, short, lamellate calluses, or a single deeply sulcate callus at the base near the apex of the column, and with the median nerve thickened or raised into a low lamella.

Mexico to Panama, Venezuela and Colombia.

Chiriquí: "Chiriquí", *Warscewicz.*

No recent Panamanian collections seen. The species grows well in cultivation.

20. Epidendrum Stangeanum Reichb. f. in Gard. Chron. n. s. 15:462. 1881.

Epidendrum glandulosum Ames, Sched. Orch. 7:5, *t. 20.* 1924.

Small repent or caespitose epiphytic herbs from a slender creeping rhizome, up to 2 dm. tall. Pseudobulbs 1.5–5 cm. long and 0.1–0.5 cm. in diameter, cylindric to narrowly fusiform, covered with marcescent sheaths, becoming naked with age, unifoliate. Leaves 4–12 cm. long and 1–3 mm. broad (or in diameter), linear and flattened or appearing terete due to their inrolled margins. Inflorescence a few- to several-flowered raceme, shorter than the subtending leaf; flowers small and inconspicuous. Dorsal sepals 5–6 mm. long and 1.5–2 mm. broad, lanceolate, acute, sparsely glandular dorsally. Lateral sepals 6–7 mm. long and 2–3 mm. broad, oblique, lanceolate, acute or acuminate, sparsely glandular dorsally. Petals 4.5–5.5 mm. long and 0.5–0.7 mm. broad, linear, acute. Lip 5–6 mm. long and 3–3.5 mm. broad, unguiculate; claw short, adnate to the column; lamina deltoid to ovate-lanceolate, apiculate, slightly cochleate, without calluses.

Costa Rica and Panama.

Canal Zone: on trail from Colón, *Powell 338;* (record without data), *Shattuck 454.*

21. EPIDENDRUM VARICOSUM Batem. in Bot. Reg. 24: Misc. p. 30. 1838; Lindl. Folia Orch. Epid. 23. 1853; Reichb. f. Xenia Orch. 1:163, *t. 56.* 1856.

Epidendrum chiriquense Reichb. f. in Bot. Zeit. 10:730. 1852, Xenia Orch. 1:164, *t. 67.* 1856.

Encyclia chiriquensis Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:472. 1918.

Small to large, repent or caespitose, epiphytic herbs up to about 1 m. tall. Pseudobulbs up to 25 cm. long, usually ovoid at the base and prolonged into a long slender neck above, 3- to 4-leaved. Leaves 5–35 cm. long and 1.5–5 cm. broad, linear-lanceolate to elliptic, acute or acuminate. Inflorescence simple or branched, shorter or longer than the leaves. Dorsal sepal 8–18 mm. long and 3–5 mm. broad, oblong to oblong-lanceolate, acute or obtuse. Lateral sepals 8–16 mm. long and 3–5 mm. broad, oblong to oblong-ovate, oblique, obtuse or acute. Petals 8–14 mm. long and 2–5 mm. broad, oblanceolate to narrowly obovate, obtuse, usually oblique. Lip 9–15 mm. long and 6–13 mm. broad, cuneate, narrowed to the base and shortly connate with the base of the column, 3-lobed; lateral lobes arising near the middle of the lip, usually small and explanate. Mid-lobe relatively large, bifid, and the lobules more or less explanate and flabellate; disc with a large central callus and with mammillate or varicose processes or lamellae from the middle extending out to the lobules of the mid-lobe. Ovary angled or narrowly winged in fruit.

Mexico, Guatemala, Salvador, Honduras, Costa Rica and Panama.

CHIRIQUÍ: "Chiriquí", *Warscewicz.*

Reichenbach first gave the origin of *Epidendrum chiriquense* as "Costa Rica und Chiriqui" and later as "Chiriqui: v. Warscewicz". The species has not been seen from Costa Rica or Panama since and the basis of *E. varicosum* in Panama is based on his record.

22. EPIDENDRUM VOLUTUM Lindl. & Paxt. in Paxton's Flow. Gard. 2:151, *fig. 215.* 1851–52.

Epidendrum Radlkoferianum Schltr. in Fedde Rep. Sp. Nov. 17:142. 1921.

Erect epiphytic herbs 18–25 cm. tall. Pseudobulbs when young 5–10 cm. long and 0.5–0.6 cm. in diameter, cylindric. Leaves 6–8 cm. long and 0.8–1 cm. broad, ligulate, acute, coriaceous. Inflorescence a lax raceme of 6–10 flowers, about 13 cm. long; peduncle 2–4 cm. long. Sepals about 1.8 cm. long and 0.3 cm. broad, narrowly oblong-ligulate, acuminate, the laterals oblique. Petals about as long as the sepals, linear, narrow and oblique, acuminate. Lip unguiculate; claw adnate to the column; lamina about 9 mm. long and 11 mm. broad, obscurely 3-lobed, subreniform-cordate, apiculate, apex triangular, apical part subcrenate and undulate; disc provided with 2 short, obtuse, parallel, lamellate calluses at the base and 3 approximate linear calluses extending up to about the middle.

Panama.

CHIRIQUÍ: "im Veragua- und Chiriquí-Distrikt", alt. 1000–1200 m., *Powell 89;* "Provinz Chiriquí", *Wagner.*

The description is taken from Schlechter's description of *E. Radlkoferianum.* The specimens indicated above are those cited by Schlechter.

Sect. II. Barkeria

23. Epidendrum stenopetalum Hook. in Bot. Mag. 62: *t. 3410.* 1835; Ames, Hub. & Schweinf. Genus Epidendrum in U. S. & Mid. Am. 179. 1936.

Dimerandra stenopetala Schltr. in Fedde Rep. Sp. Nov. Beih. 17:44. 1922.

Slender, caespitose, epiphytic herbs up to about 4 dm. tall. Stems terete, cylindric, cane-like, often somewhat flexuose, leafy. Leaves 3.5–14 cm. long and 0.4–1 cm. broad, linear or ligulate to linear-oblong or linear-lanceolate, obtuse, unequally bilobulate at the apex, scattered along the stem, one at each node. Inflorescence a short, few-flowered raceme. Dorsal sepal 10–13 mm. long and 3.5–4.5 mm. broad, lanceolate or elliptic-lanceolate, acute or acuminate. Lateral sepals 10–13 mm. long and 3.5–4.5 mm. broad, lanceolate to lanceolate-ovate, acute or acuminate, somewhat oblique. Petals 11–13 mm. long and 6–6.5 mm. broad, obovate to subrhombic, acute or acuminate. Lip 11–13 mm. long and 8–9.5 mm. broad, obovate to obovate-flabellate, truncate; disc obscurely lined. Column short, the clinandrium with 2 large lateral lobes.

Mexico, Guatemala, British Honduras, Honduras, Costa Rica, Panama, the West Indies and South America at low elevations.

BOCAS DEL TORO: Water Valley, *Wedel 765.* CANAL ZONE: drowned forest near Vigía and San Juan on Río Pequeni, *Dodge, Steyermark & Allen 16586;* hills near Panamá City, *Powell 17, 3451;* Las Cruces trail, *Standley 29101;* between France Field and Corozal, *Standley 30448.* PANAMÁ: swamp east of Río Tecúmen, *Standley 26610.*

This species is placed in section Barkeria by Ames, Hubbard & Schweinfurth (loc. cit.), but it has little relationship to the other species of the section; it would perhaps be best placed in a section by itself.

III. Section Euepidendrum

24. Epidendrum Allenii L. Wms. in Ann. Missouri Bot. Gard. 28:418, *t. 22, figs. 3–5.* 1941.

Erect epiphytic herbs up to about 3 dm. tall. Stems ancipitous, covered with the bases of the 3 to 6 leaves. Leaves 4–12 cm. long, 1.2–3 cm. broad, elliptic to lanceolate, acute or short-acuminate. Peduncle about 10–15 cm. long, ancipitous, bialate, the wings prominent at the base but disappearing at about the middle of the peduncle. Inflorescence short, the rachis covered with the scarious, imbricated bracts; bracts up to about 1 cm. long. Dorsal sepal about 10 mm. long and 4 mm. broad, lanceolate, obtuse, 5- to 7-nerved, with a short dorsal apicule near the apex. Lateral sepals similar to the dorsal sepal except somewhat arcuate. Petals about 10 mm. long and 0.75 mm. broad, linear, 1-nerved. Lip unguiculate; the lamina about 10 mm. long and 12 mm. broad, subreniform, subentire or ob-

Fig. 123. *Epidendrum ellipsophyllum* and *E. Allenii*

Fig. 124. *Epidendrum anceps*

scurely 3-lobed, the terminal lobe inconspicuous and slightly retuse, with 2 approximate submammillar calluses at the base. Column of the section, about 7 mm. long.

Panama.

COCLÉ: hills north of El Valle de Antón, alt. 1000 m., *Allen 2203, 2310.*

25. EPIDENDRUM ANCEPS Jacq. Select. Stirp. Am. 224, *t. 138.* 1763; Ames, Hub. & Schweinf. Genus Epidendrum in U. S. & Mid. Am. 56. 1936.

Epidendrum musciferum Lindl. in Hook. Jour. Bot. 1:6. 1834.

Epiphytic herbs up to about 1 m. tall. Stems slender to rather coarse, covered with the amplexicaul leaf-sheaths, usually ancipitous. Leaves 4–25 cm. long and 1–5 cm. broad, ligulate to elliptic-lanceolate, acute or obtuse, those at the middle of the stem or above usually largest, the lower ones reduced. Inflorescence usually long-pedunculate (up to 45 cm.), simple or branched, racemose or subcapitate; peduncle ancipitous, covered with scarious sheaths. Dorsal sepal 5–10 mm. long and 2–3.5 mm. broad, elliptic to elliptic-ovate, acute or obtuse. Lateral sepals 6–10 mm. long and 2–4 mm. broad, oblong-lanceolate to ovate, obtuse or acute, oblique, semi-cochleate. Petals 4–9 mm. long and 0.5–1.5 mm. broad, filiform to linear-oblanceolate. Lip unguiculate; claw adnate to the column; lamina 3–6 mm. long and 4–7.5 mm. broad, reniform to cordate-suborbicular, 3-lobed; the lateral lobes rounded, fleshy; terminal lobe subquadrate to oblong, entire, retuse or doubly retuse; disc fleshy, usually with a low longitudinal callus from base to apex.

Florida and Mexico through Central America and the West Indies to Brazil and Peru.

BOCAS DEL TORO: Old Bank Island, *Wedel 2081;* Bastimentos Island, *Wedel 2921.* CANAL ZONE: Gatún Lake, Frijoles, San Juan, Fort Sherman, *Powell 40, 41, 3349, 3366, 3367;* Barro Colorado Island, *Woodworth & Vestal 66A.* CHIRIQUÍ: Lino Hill, alt. 1200–1500 m., *Powell 299.* PANAMÁ: Cerro Campana, alt. 1000 m., *Allen 2452;* Panamá City, *Kieswetter s. n.*

26. EPIDENDRUM BISULCATUM Ames, Sched. Orch. 5:24, *t. 5.* 1923.

Small, branched, epiphytic herbs up to about 50 cm. long. Stems slender, much branched, covered with the scarious leaf-sheaths when young, becoming naked with age. Leaves 4–10 cm. long and 0.6–2 cm. broad, elliptic to lanceolate to oblanceolate, acute. Inflorescence shorter than the leaves, 1- to few-flowered, borne on a short winged peduncle. Flowers greenish, the lip with a purple cast. Dorsal sepal 7–10 mm. long and 3–6 mm. broad, oval to oblong-ligulate, acutish. Lateral sepals 10–12 mm. long and 3–6 mm. broad, oblong to oblong-oval, oblique, acute. Petals 7–10 mm. long and 1.5–2 mm. broad, linear, obtuse. Lip unguiculate; the claw adnate to the column; lamina 7–10 mm. long and 9–13 mm. broad, suborbicular-cordate, crenulate, obscurely emarginate, fleshy, provided with 2 (or 3) submammillate calluses at the base which are prolonged into low

Fig. 125. *Epidendrum bisulcatum*

(274)

fleshy keels and with a low keel passing between the mammillae.

Panama.

CHIRIQUÍ: Bajo Chorro, Boquete District, alt. 1800 m., *Davidson 122, 322;* Palo Alto Hill, alt. 1800 m., *Powell 280, 281.*

27. EPIDENDRUM CALIGARIUM Reichb. f. in Gard. Chron. 1869:1110. 1869; Ames, Sched. Orch. 9:48, *fig. 8.* 1925.

Caespitose epiphytic herbs up to about 80 cm. long. Stems slender, strict, covered with loosely appressed sheaths, the sheaths densely maculated with minute, purple, papillose or tuberculate excrescences. Leaves 1.5–6 cm. long and 0.3–0.6 cm. broad, linear or linear-lanceolate, borne near the apex of the stem. Inflorescence exceeding the leaves, a densely flowered simple or branched raceme. Sepals

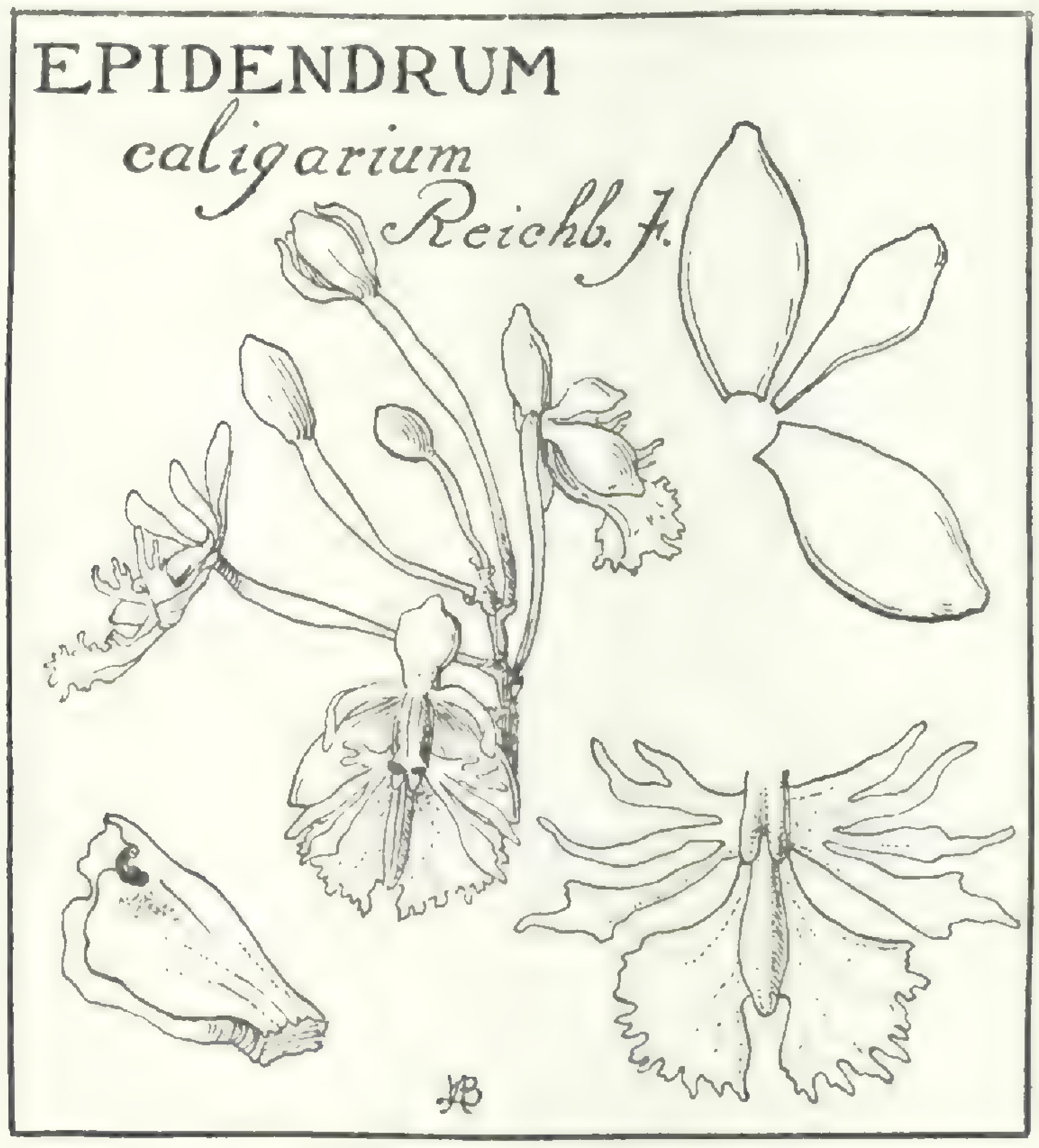

Fig. 126. *Epidendrum caligarium*

5–6 mm. long and 2.5–3 mm. broad, oval, obtuse or obscurely apiculate. Petals 5–6 mm. long and about 1.5 mm. broad, elliptic-oblanceolate. Lip unguiculate; the claw adnate to the column; lamina 6–8 mm. long and 8–10 mm. broad, more or less orbicular in outline, 3-lobed, the lateral lobes deeply lacerate, often cut nearly to the middle of the lip, each lobe often 4-partite, mid-lobe deeply retuse, the lateral lobules denticulate or laciniate; disc provided with 2 small antrorse, submammillate calluses at the base.

Known definitely only from Panama.

VERAGUAS: San Juan, alt. 360 m., *Powell 380.*

28. Epidendrum Carolii Schltr. in Fedde Rep. Sp. Nov. Beih. 19:35. 1923.

Erect, caespitose, epiphytic herbs up to about 40 cm. tall. Stems 3–12 cm. long, slender, covered with the scarious leaf-sheaths, becoming naked with age, bearing leaves toward the apex. Leaves 2.5–8 cm. long and 0.7–2 cm. broad, elliptic-lanceolate or oblong. Inflorescence up to 30 cm. long, long-pedunculate, a simple or branched raceme; peduncle ancipitous, covered with several equitant scarious bracts. Flowers small, usually purplish with a yellow lip. Dorsal sepal 5–6 mm. long and 1.5–2 mm. broad, lanceolate to oblong, acute or obtuse. Lateral sepals similar to the dorsal but oblique. Petals 3–5 mm. long and 1–1.8 mm. broad, linear to linear-oblong, slightly arcuate, obscurely denticulate. Lip unguiculate; claw adnate to the column; lamina 4–5 mm. long and as broad, ovate-cordate, crenulate, fleshy, the disc with a longitudinal callus well developed and joining the two erect lateral lobes of the lip.

Mexico, Costa Rica and Panama.

chiriquí: Boquete, alt. 1150 m., *Davidson 1058.*

29. Epidendrum centradenia Reichb. f. in Walp. Ann. 6: index p. 1163. 1865.

Oerstedella centradenia Reichb. f. in Bot. Zeit. 10:932. 1852.
Epidendrum tenuiflorum Schltr. in Fedde Rep. Sp. Nov. 3:49. 1906.

Caespitose or spreading and proliferous epiphytic herbs up to 0.5 m. or perhaps longer. Stems slender, covered with the amplexicaul, minutely papillose or tuberculate leaf-sheaths, becoming naked with age, simple or branched, bearing leaves mainly toward the apex of the new growths. Leaves 2–9 cm. long and 0.2–0.8 cm. broad, linear to linear-lanceolate, acute. Inflorescence 1- to few-flowered; flowers lilac-colored. Sepals 7–10 mm. long and 2–3 mm. broad, linear-lanceolate, acute. Petals 7–10 mm. long and 1.5–2 mm. broad, linear-oblanceolate, obtuse, slightly oblique. Lip 10–18 mm. long and 9–17 mm. broad, unguiculate; the narrow claw adnate to the column; lamina 3-lobed, lateral lobes small, about 3 mm. long, explanate, mid-lobe relatively large, deeply retuse and with the two large divaricate lobules cuneate to the junction with the lateral lobes; disc provided with a small hood-shaped tridentate callus at the base of the lamina. Column with a large hood-shaped or calyptriform clinandrium.

Costa Rica and Panama.

chiriquí: "Province of Chiriquí", alt. 1200 m., *Powell 139.*

30. Epidendrum centropetalum Reichb. f. in Bot. Zeit. 10:732. 1852.

Oerstedella centropetala Reichb. f. loc. cit. 932.
Epidendrum aberrans Schltr. in Fedde Rep. Sp. Nov. 15:206. 1918.
Epidendrum leprosum Schltr. in Fedde Rep. Sp. Nov. Beih. 19:38. 1923.

Caespitose or repent epiphytic herbs up to 65 cm. tall. Stems slender, covered with the leaf-sheaths or naked with age, simple or branched, bearing leaves mainly toward the apex; leaf-sheaths verrucose or tuberculate. Leaves 2.5–8 cm. long and 0.3–1.5 cm. broad, linear-lanceolate to lanceolate, acute or obtuse. Inflores-

cence a simple few- to several-flowered raceme exceeding the leaves; flowers small, rose to purple. Dorsal sepal 7–9 mm. long and 2–3 mm. broad, elliptic to oblanceolate, obtuse or acute. Lateral sepals 7–10 mm. long and 2–3.5 mm. broad, oblong or oblanceolate, acute, arcuate. Petals 6–9 mm. long and 1–2.3 mm. broad, linear-oblanceolate, obtuse. Lip unguiculate, strongly 3-lobed; claw at the base adnate to the column, free above, fleshy and provided with a raised sulcate and retuse callus reaching to about the lateral lobes; lamina strongly 3-lobed, the mid-lobe strongly bilobed, lateral lobes 2–4 mm. long, explanate, oblong, obtuse; terminal lobe clawed and the two lobules explanate to recurved, the lobules oblong, obtuse or acute. Column provided with a hood-shaped or calyptriform clinandrium.

Guatemala, Honduras, Costa Rica and Panama.

CHIRIQUÍ: Chiriquí Volcano, *Warscewicz.*

31. EPIDENDRUM COCLÉENSE Ames, Hub. & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 4:6. 1936.

Scandent epiphytic herbs up to about 2.5 m. long. Stems simple or branched, covered with the amplexicaul leaf-sheaths or naked with age. Leaves 4–10 cm. long and 4–6 mm. broad, linear or ensiform, acute. Inflorescence short, 1- to 3-flowered, shorter than the subtending leaves; sheath up to 15 cm. long, subimbricated, scarious, cucullate, exceeding the pedicels of the flowers. Dorsal sepals about 8 mm. long and 2.5 mm. broad, linear-oblong, obtuse. Lateral sepals about 10 mm. long and 3.5 mm. broad, lanceolate, acute, shortly alate-keeled dorsally at the apex. Petals about 8 mm. long and 2 mm. broad, oblanceolate, acute. Lip unguiculate, fleshy; claw adnate to the column; lamina about 6 mm. long and 4 mm. broad, oblong-ovate, simple, obtuse, provided with a small tridentate callus under the apex of the column, the middle tooth of which is prolonged into a longitudinal carina.

Panama.

COCLÉ: El Valle de Antón, alt. 500 m., *Hunter & Allen 389.*

32. EPIDENDRUM CONFERTUM Ames & Schweinf. Sched. Orch. 10:61. 1930.

Epidendrum prostratum Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:407. 1918, non Cogn.

Branched or simple, prostrate epiphytic herbs up to 50 cm. long. Stems slender, densely leaved, covered with the amplexicaul leaf-sheaths. Leaves 8–15 mm. long and 3–6 mm. broad, oblong-ligulate to ovate, acute to aristate. Inflorescence usually a single flower at the apex of the stem or branches. Sepals 8–9 mm. long and 2–2.5 mm. broad, lanceolate-ligulate, acute. Petals about 8 mm. long and 1 mm. broad, linear, obtuse or acute, broadest near the apex. Lip unguiculate; claw adnate to the column; lamina about 5 mm. long and as broad, orbicular-cordate, slightly cochleate.

Costa Rica and Panama.

CHIRIQUÍ: Bajo Chorro, Boquete District, alt. 1800 m., *Davidson 246.*

33. Epidendrum congestum Rolfe in Kew Bull. 1913:29. 1913.

Epidendrum serruliferum Schltr. in Fedde Rep. Sp. Nov. Beih. 19:44. 1923.

Small, densely caespitose herbs up to 7 cm. tall. Stems short, covered with the broad equitant bases of the leaves. Inflorescence 1- to few-flowered, sessile in the axils of the terminal leaves. Leaves 8–30 mm. long and 4–8 mm. broad, linear-oblong to oblong-oval, obtuse, approximate, semi-equitant, spreading, fleshy. Dorsal sepal 7–9 mm. long and 3–4 mm. broad, lanceolate, acute to acuminate. Lateral sepals 8–10 mm. long and 2–3 mm. broad, lanceolate, cucullate, alate-keeled dorsally and the keel denticulate, oblique, connate at the base with the claw of the lip. Petals 7–8 mm. long and 2–2.5 mm. broad, lanceolate, acute, minutely denticulate. Lip 7–10 mm. long, long-unguiculate; claw adnate to the column but exceeding it slightly; lamina 4–5 mm. long and 3–4 mm. broad, lanceolate-cordate to cordate, acute or acuminate, fleshy, lobes more or less erect. Clinandrium not fimbriate.

Costa Rica and Panama.

coclé: vicinity of El Valle, alt. 600–1000 m., *Allen 1247*.

34. Epidendrum coriifolium Lindl. in Jour. Hort. Soc. Lond. 6:218, *fig. 1851;* Summerhayes in Bot. Mag. 160: *t. 9477*. 1937.

Epidendrum magnibracteatum Ames, Sched. Orch. 1:16. 1922, non Kränzlin.
Epidendrum coriifolium Lindl. var. *purpurascens* Schltr. in Fedde Rep. Sp. Nov. Beih. 17:31. 1922.
Epidendrum fuscopurpureum Schltr. loc. cit. 32.
Epidendrum palmense Ames, loc. cit. 2:33. 1923.
Epidendrum subviolascens Schltr. loc. cit. 19:219. 1923.

Erect, caespitose or repent, epiphytic herbs up to about 40 cm. tall. Stems indurated, covered toward the base with sub-scarious sheaths and above by the amplexicaul leaf-sheaths, bearing 2–4 leaves above. Leaves 7–30 cm. long and 1–4.5 cm. broad, ligulate or ligulate-oblong, obtuse, apex bilobed, keeled dorsally along the mid-nerve. Inflorescence up to 30 cm. long, with up to 15 flowers, the peduncle enveloped in the imbricated floral-bracts; bracts 15–65 mm. long and 10–30 mm. broad when spread out, strongly cucullate, obtuse; flowers variable in size, greenish or the lip purplish. Dorsal sepal 15–25 mm. long and 3.5–6 mm. broad, lanceolate, acute. Lateral sepals 15–25 mm. long and 5–11 mm. broad, lanceolate to ovate-lanceolate, acute, oblique. Petals 14–20 mm. long and 1.5–2.5 mm. broad, linear to linear-oblanceolate, acute. Lip unguiculate; the claw adnate to the column; lamina 12–25 mm. long and 14–28 mm. broad, cordate-reniform, usually retuse or bilobed at the apex, fleshy, provided with a longitudinal callus-thickening, entire or serrulate.

Mexico, Guatemala, Costa Rica, Panama, Venezuela, Ecuador and Peru.

chiriquí: Bajo Chorro, Boquete District, alt. 1800 m., *Davidson 245;* province of Chiriquí, alt. 1200 m., *Powell 19, 3394*. coclé: region north of El Valle de Antón, alt. 1000 m., *Allen 2901*.

A variable species that has been much described.

35. EPIDENDRUM CRINIFERUM Reichb. f. in Gard. Chron. 1291. 1871; Hook. f. in Bot. Mag. 100: *t. 6094.* 1874.

Erect, caespitose, epiphytic herbs up to 50 cm. tall. Stems slender, strict, simple, covered with the amplexicaul leaf-sheaths or naked below. Leaves 5–13 cm. long and 0.5–1.5 cm. broad, elliptic-linear to linear-lanceolate, acute, erect or spreading. Inflorescence a simple few-flowered raceme, peduncle covered with several large imbricated spathe-like bracts at the base. Sepals 10–25 mm. long and 2–3 mm. broad, linear-lanceolate to lanceolate, acute or acuminate. Petals 10–20 mm. long and about 1 mm. broad, filiform. Lip unguiculate; claw adnate to the column; lamina strongly 3-lobed, the lateral lobes semi-ovate with crenate or laciniate margins and the setae usually recurved, the mid-lobe 5–12 mm. long and linear or filiform, disc provided with 2 tubercular calluses at the apex of the column.

Costa Rica, Panama and Peru.

COCLÉ: north rim of El Valle de Antón, alt. 600–1000 m., *Allen 1679.*

36. EPIDENDRUM CRYPTANTHUM L. Wms. in Am. Orch. Soc. Bull. 11:249, *t. 7.* 1942.

Repent, branched, epiphytic herbs up to about 40 cm. long. Stems slender, covered with the scarious amplexicaul leaf-sheaths, becoming naked with age, arcuate, continuing the growth from about the middle of the previous year's growth, unilateral in origin, somewhat swollen toward the apex of each growth. Leaves 5.5–8 cm. long and 1.7–3 cm. broad, elliptic to elliptic-ovate, acute, coriaceous, 2–3 at the apex of each growth. Inflorescence about 3 cm. long, a short, congested subcapitate raceme; bracts conspicuous, ovate or ovate-oblong, entire or lacerate toward the apex; flowers small, hidden by the subtending bracts. Dorsal sepal about 10 mm. long and 3 mm. broad, elliptic-oblong, obtuse. Lateral sepals 10–11 mm. long and 3.5–4 mm. broad, elliptic-oblong or elliptic-oval, obtuse or acutish, arcuate. Petals about 10 mm. long and 3.5–4 mm. broad, oblanceolate-oblong, obtuse. Lip short-unguiculate; lamina about 10 mm. long and 8 mm. broad, obovate, cordate at the base, the apex apiculate, lateral margins involute; disc fleshy.

Panama.

COCLÉ: hills north of El Valle de Antón, alt. 800–1000 m., *Allen 2262.*

37. EPIDENDRUM DENTIFERUM Ames & Schweinf. Sched. Orch. 8:42. 1925.

Epidendrum platychilum Schltr. in Fedde Rep. Sp. Nov. Beih. 19:42. 1923, non Schltr. 1921.

Small, repent, epiphytic herbs up to about 10 cm. long. Stems slender, simple or branched, covered with the scarious leaf-sheaths or becoming naked. Leaves 2–7 cm. long and 0.3–0.5 cm. broad, linear or ligulate. Inflorescence terminal, few-flowered; flowers relatively large for the plant. Dorsal sepal 8–15 mm. long

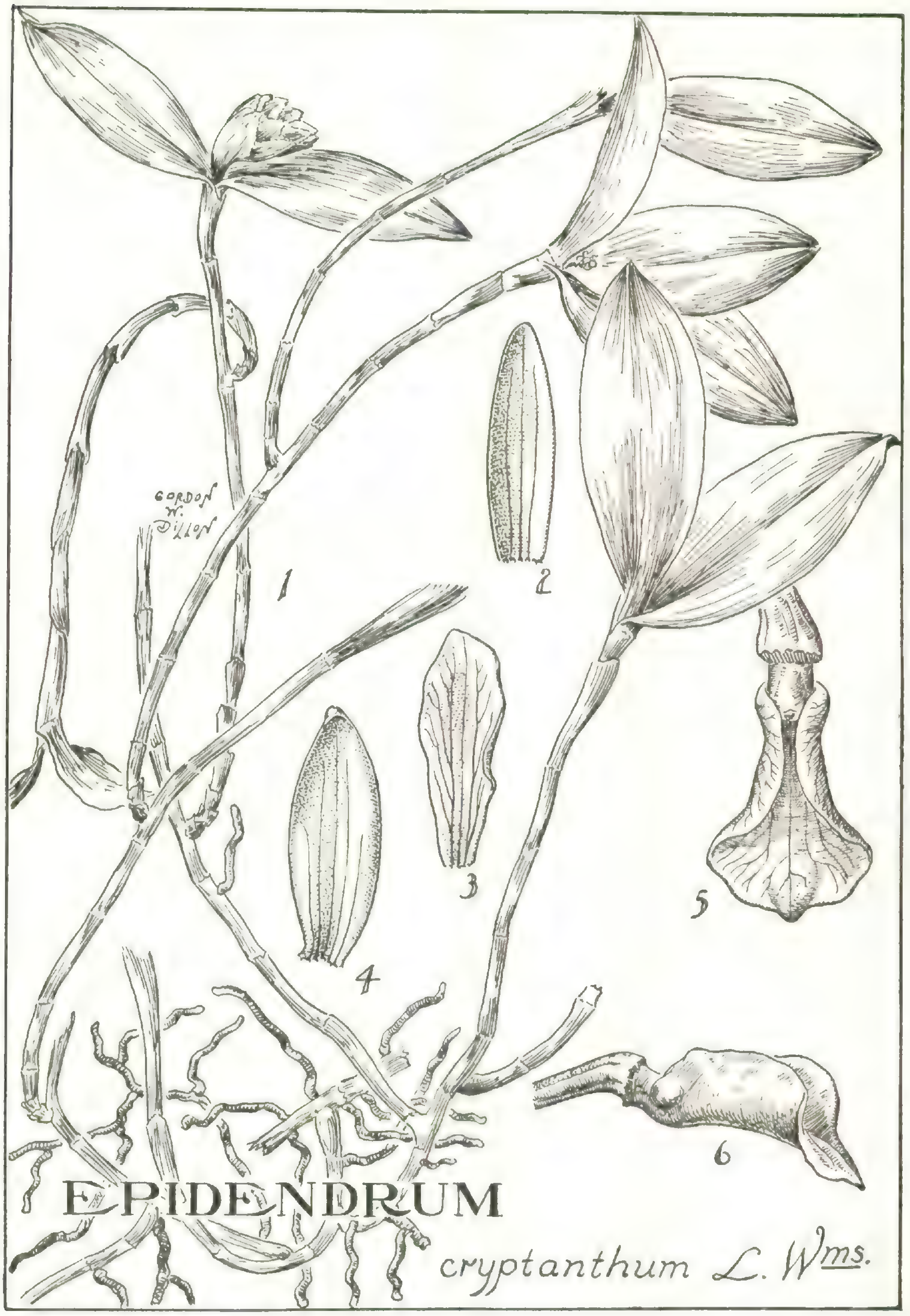

Fig. 127. *Epidendrum cryptanthum*

and 2–2.5 mm. broad, lanceolate, acute. Lateral sepals 9–16 mm. long and 2.5–3.5 mm. broad, lanceolate, acuminate, arcuate. Petals 8–15 mm. long, filiform or subulate. Lip simple, unguiculate; claw adnate to the column; lamina 7–13 mm. long and 8–14 mm. broad, suborbicular or suborbicular-reniform, mucronate, provided with 2 small basal calluses.

Costa Rica and Panama.

DARIÉN: Cana Cuasi trail, Chepigana District, alt. 2400 m., *Terry & Terry 1412.*

38. EPIDENDRUM DENTILOBUM Ames, Hub. & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 3:69. 1935.

Erect, caespitose, epiphytic herbs up to about 30 cm. tall. Stems slender, simple, covered with the scarious leaf-sheaths or naked below. Leaves 6–10 cm. long and 1.2–1.8 cm. broad, elliptic, acute. Inflorescence simple or branched, few-flowered; flowers inadequately known. Dorsal sepal about 12 mm. long and 5 mm. broad, concave, narrowly oval. Lateral sepals about 10 mm. long and 6 mm. broad, oblong-oval, oblique, acute. Petals about 11 mm. long and 5.5 mm. broad, spatulate-oblanceolate, oblique, obtuse. Lip unguiculate; claw short, adnate to the column; lamina 3-lobed, about 7 mm. long and 8 mm. broad; lateral lobes small, dentiform, narrowly triangular-lanceolate, explanate, about 1.5–2 mm. long; terminal lobe largest, semicircular-flabellate, cuneate to the base; disc with 3 thickened, carinate nerves, the central one most prominent and with a mammillate callus at the base.

Panama.

CANAL ZONE: hills back of San Juan, alt. sea-level, *Powell 342.*

The available material of this species is inadequate.

39. EPIDENDRUM DIFFORME Jacq. Enum. Pl. Carib. 20. 1760; Select. Stirp. Am. 223, *t. 136.* 1763.

Epidendrum umbellatum Sw. Nov. Gen. & Sp. Prodr. 121. 1788.
Epidendrum latilabrum Lindl. in Bot. Reg. 27: Misc. p. 77. 1841.
Epidendrum chlorocorymbos Schltr. in Fedde Rep. Sp. Nov. Beih. 17:30. 1922.
Epidendrum curvicolumna Ames, Hub. & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 3:67. 1935.

Caespitose or repent, epiphytic herbs up to 50 cm. tall. Stems fractiflex to straight, covered with the pergameneous, amplexicaul, occasionally infundibuliform leaf-sheaths. Inflorescence a short, few- to many-flowered, subumbellate raceme; flowers greenish or yellowish, long-pedunculate. Leaves 2–12 cm. long and 0.5–3.5 cm. broad, variable, from linear-oblong to elliptic-oval, obtuse. Dorsal sepals 14–35 mm. long and 2–4 mm. broad, linear-elliptic to lanceolate or oblanceolate, acute. Lateral sepals 12–35 mm. long and 3–6 mm. broad, elliptic to oblanceolate, acute, oblique. Petals 7–30 mm. long and 1–5 mm. broad, filiform to linear to oblanceolate, acute. Lip 7–18 mm. long and 12–30 mm. broad, unguiculate; claw adnate to the column; lamina transverse, reniform, broader than long, obscurely to prominently 3-lobed; mid-lobe usually bifid and longer

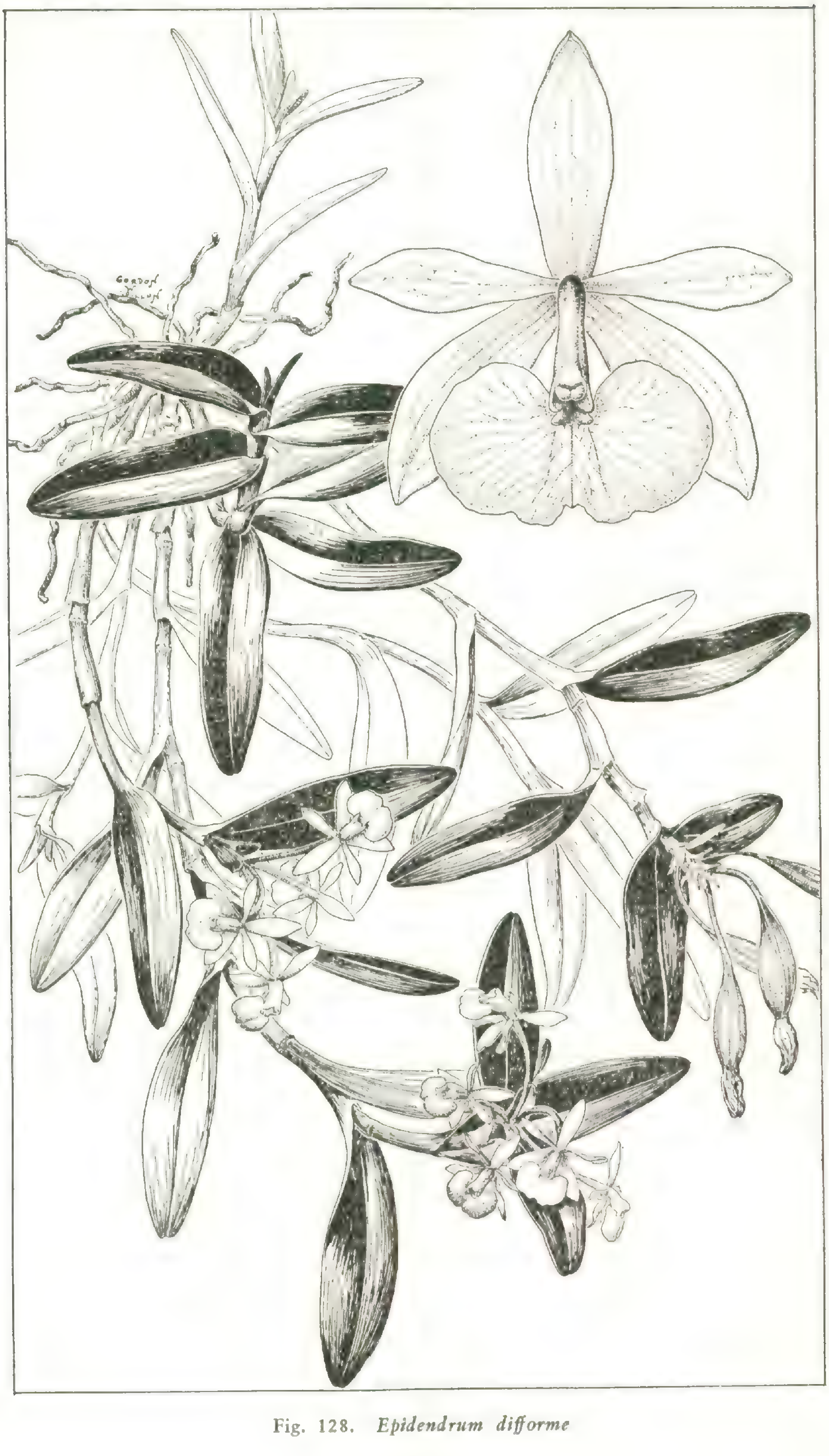

Fig. 128. *Epidendrum difforme*

than the lateral lobes.

From Florida and Mexico through Central America and the West Indies to Brazil and Peru.

CHIRIQUÍ: Bajo Chorro, alt. 1800 m., *Davidson 182;* Volcán de Chiriquí, alt. 2100 m., *Davidson 885;* David, alt. 30–80 m., *Pittier 2845;* Lino Hill, alt. 1200–1500 m., *Powell 296;* Monte Lirio, alt. 1300–1900 m., *Seibert 211.* COCLÉ: hills north of El Valle de Antón, alt. 800–1000 m., *Allen 2287, 2293;* Valle Chiquito, alt. 700–800 m., *Seibert 514;* San Juan, Chorrera, Paja and Frijoles, *Powell 82, 249, 304, 3259, 3292, 3293, 3294, 3389.*

A variable and widely distributed species which may include *E. Barbeyanum* Kränzl., a species reported from Panama by garden specimen. The two following varieties are hardly distinct.

39a. EPIDENDRUM DIFFORME Jacq. var. FIRMUM (Reichb. f.) Ames, Hub. & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 2:55. 1934.

Epidendrum firmum Reichb. f. Beitr. Orch. Centr.-Am. 87. 1866.
Epidendrum majale Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:406. 1918.

Distinguished from the species in having the mid-lobe of the lip "at most little broader than long, subquadrate."

Guatemala, Costa Rica and Panama.

CHIRIQUÍ: Finca Lérida to Peña Blanca, alt. 1750–2000 m., *Woodson & Schery 298.*

39b. EPIDENDRUM DIFFORME Jacq. var. SIMULACRUM (Ames) Ames, Hub. & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 2:57. 1934.

Epidendrum simulacrum Ames, Sched. Orch. 6:75. 1923.

A small-flowered variant of the species, said to be distinguished from "small-flowered specimens of the typical form of the species in having the mid-lobe of the lip a little broader than long."

Panama.

CHIRIQUÍ: Lino Hill, alt. 1200–1500 m., *Powell 298.*

40. EPIDENDRUM EBURNEUM Reichb. f. in Gard. Chron. 404. 1867; Hook. f. in Bot. Mag. 93: *t. 5643.* 1867.

Epidendrum leucocardium Schltr. in Fedde Rep. Sp. Nov. 12:206. 1913.

Slender, caespitose, epiphytic herbs up to about 50 cm. tall. Stems strict, covered with amplexicaul leaf-sheaths, becoming naked below. Leaves 3–14 cm. long and 0.8–2.5 cm. broad, elliptic to lanceolate, obtuse or acute. Inflorescence short, usually exceeded by the leaves, rachis strongly fractiflex; flowers rather large, white. Dorsal sepal 22–36 mm. long and 2.5–4 mm. broad, linear-lanceolate, acute or acuminate. Lateral sepals 22–36 mm. long and 3–4 mm. broad, linear-lanceolate, acute or acuminate, slightly oblique. Petals 20–35 mm. long and 1–2 mm. broad, filiform. Lip with claw adnate to the column; lamina 20–30 mm. long and 22–28 mm. broad, orbicular-cordate to subquadrate or transversely orbicular-oblong, usually apiculate, entire or rarely lobed (one flower seen with

distinct sinuses); disc with 2 mammillate calluses at the base near the apex of the column.

Panama, near sea-level.

BOCAS DEL TORO: vicinity of Chiriquí Lagoon, *Wedel 850, 1625, 2556, 2766.* CANAL ZONE: Gatún Lake, near Colón, *Powell 38, 132, 3462;* "a few miles from Colón in swamps," *Henderson.* COLÓN: Río Indio de Fató, *Pittier 4266.*

41. EPIDENDRUM ELLIPSOPHYLLUM L. Wms. in Ann. Missouri Bot. Gard. 28:419, *t. 22, figs. 1–2.* 1941.

Erect epiphytic herbs up to about 25 cm. tall. Stems slightly fusiform and indurated, with only the annual leaves persisting and the sheaths of the older leaves becoming scarious and disintegrating. Leaves 11–12 cm. long and 2–2.8 cm. broad, elliptic, short-acuminate, usually only 2 or 3 persisting. Peduncles up to about 4 cm. long, ancipitous, generally covered with imbricated bracts. Inflorescence short, 1-, or at most few-,flowered; bracts up to about 2 cm. long, cucullate, lanceolate-triangular, acute; flowers green, segments stiff and coriaceous. Sepals 10–12 mm. long and 3–4 mm. broad, elliptic to oblanceolate, obtuse, 5-nerved. Petals about 10–11 mm. long and 3–4 mm. broad, oblanceolate, obtuse, with 3 principal nerves. Lip unguiculate, the claw mostly adnate to the column; lamina 5–6 mm. long and 5–6 mm. broad, orbicular-ovate in outline, 3-lobed, the lateral lobes small and situated toward the base of the lip, with a 2-ridged lamellate callus plate at the junction of the claw and the lamina. Column slender, about 8 mm. long; clinandrium entire and obtuse; pollinia not seen.

Panama.

COCLÉ: hills north of El Valle de Antón, alt. 1000 m., *Allen 2178, 2706.*

This species is illustrated in fig. 123.

42. EPIDENDRUM ENDRESII Reichb. f. in Gard. Chron. n. s. 19:432. 1883; Hook. f. in Bot. Mag. 128: *t. 7855.* 1902.

Epidendrum Adolphi Schltr. in Fedde Rep. Sp. Nov. 3:108. 1906.

Caespitose or repent, epiphytic herbs up to about 30 cm. long. Stems slender, simple or branched; the amplexicaul leaf-sheaths verrucose and tuberculate. Leaves 1–4.5 cm. long and 0.5–1.5 cm. broad, ovate to oblong-lanceolate, obtuse, coriaceous. Inflorescence a simple, few-flowered raceme; flowers white tinged with purple. Dorsal sepal 8–10 mm. long and 3–5 mm. broad, elliptic to oval, acute. Lateral sepals 9–11 mm. long and 3.5–4.5 mm. broad, ovate-oblong, acute. Petals 8–11 mm. long and 2.5–5 mm. broad, oblanceolate-spatulate to obovate-spatulate, obtuse, slightly oblique. Lip unguiculate; claw adnate to the column; lamina 7–12 mm. long and 6–10 mm. broad, 3-lobed; lateral lobes 2–4 mm. long, explanate, subtriangular, obtuse or acute; mid-lobe bifid with the lobules spreading; disc provided with 2 submammillate calluses under the apex of the column.

Costa Rica and Panama.

CHIRIQUÍ: Bajo Chorro, Boquete District, alt. 1800 m., *Davidson 323.*

43. EPIDENDRUM EQUITANTIFOLIUM Ames, Sched. Orch. 4:39. 1923.

Epidendrum equitans Lindl. in Bot. Reg. 24: Misc. p. 44. 1838, non Forst. f. nec Ruiz & Pavon.

Erect or pendent, caespitose, epiphytic herbs up to about 4 dm. long. Stems slender, leafy, ancipitous. Leaves 8–27 cm. long and 0.4–1.2 cm. broad, equitant, ancipitous, linear-lanceolate, acute or acuminate, fleshy. Inflorescence borne on an ancipitous, winged peduncle up to 25 cm. long and simulating a leaf, 1- to few-flowered, subcapitate, subtended by a reduced leaf-like bract. Flowers small, dull-colored. Sepals 12–17 mm. long and 1.5–2.5 mm. broad, linear to linear-oblong or elliptic, acute or obtuse. Petals 8–13 mm. long and 1–2 mm. broad, linear-oblanceolate to linear-elliptic. Lip unguiculate; the claw adnate to the column for about half its length; lamina 7–9 mm. long and 5–6 mm. broad, 3-lobed, provided with a callus on the claw at the base; lateral lobes semi-orbicular; terminal lobe lanceolate to triangular-lanceolate; disc concave or cochleate.

Mexico, British Honduras, Honduras and Panama.

CANAL ZONE: hills east of Panamá City, *Powell 206, 3409*. CHIRIQUÍ: "Province of Chiriquí", alt. 900–1050 m., *Powell 206*.

44. EPIDENDRUM EXASPERATUM Reichb. f. Beitr. Orch. Centr.-Am. 87. 1866.

Epidendrum chondranthum Kränzl. in Vierteljahrschr. Naturforsch. Ges. Zürich 74:136. 1929.

Erect, caespitose, epiphytic herbs up to about 3 dm. tall, normally less. Stems slender to thickened, simple or branched, covered with amplexicaul leaf-sheaths, becoming naked with age. Leaves 4–13 cm. long and 0.5–4.5 cm. broad, elliptic to lanceolate to lanceolate-oblong, obtuse or acute, those on branches smallest and narrowest. Inflorescences either terminal or lateral or both, the lateral ones originating opposite the base of a leaf, simple or paniculate. Flowers greenish or whitish and mottled with red or purple. Dorsal sepal 8–14 mm. long and 3–6 mm. broad, oblong-lanceolate, obtuse or acute, cucullate, fleshy, verrucose to mammillate dorsally, the mid-nerve prolonged into a subterminal apicule. Lateral sepals similar but elliptic-oblong and usually oblique. Petals 8–11 mm. long and 2–4 mm. broad, oblanceolate, obtuse. Lip unguiculate, the claw adnate to the column, fleshy or callus-thickened; lamina 7–13 mm. long and about as broad, prominently 3-lobed; lateral lobes spreading, originating about opposite the apex of the column, oblong, oblique, obtuse, 3–5 mm. long, rarely lobulate or dentate; mid-lobe bilobulate, emarginate, the lobules divergent to explanate, rarely dentate, obtuse; disc usually provided with a low callus-thickening which extends from the claw to the isthmus between the lateral lobes and usually is terminated by two mammillate processes, rarely continuous from base to apex,—often obscurely verrucose. Column provided with 2 thin stelidia at the apex over the anther.

Costa Rica and Panama.

CHIRIQUÍ: south slope of Volcán de Chiriquí, Boquete District, alt. 2900 m., *Terry & Terry 1343;* trail from Potrero Muleta to Finca Lérida, *Woodson & Schery 475.*

45. EPIDENDRUM HUNTERIANUM Schltr. in Fedde Rep. Sp. Nov. Beih. 17:33. 1922.

Pendent or erect epiphytic herbs up to about 30 cm. long. Stems simple, somewhat compressed, densely leaved. Leaves to 7.5 cm. long and 4 cm. broad, oblong or broadly oblong, obtuse, unequally bilobed. Inflorescence short, terminal, 4- to 6-flowered, subumbellate; bracts ovate, obtuse to acuminate. Sepals about 1.5 cm. long, oblong-ligulate, subacute, the laterals oblique. Petals about as long as the sepals but narrower, lanceolate-ligulate, subacute, narrowed at the base. Lip unguiculate, the claw adnate to the column; lamina about 11 mm. long and about 10 mm. broad, suborbicular-cordate, very obtuse, base with 2 oblique calluses, median nerves thickened.

Panama.

CANAL ZONE: Im Überschwemmungsgebiete des Gatun-Sees, *Powell 29.*

No specimens were seen of this species. Description taken from the original.

46. EPIDENDRUM IBAGUENSE HBK. Nov. Gen. & Sp. Pl. 1:352. 1816; C. Schweinf. in Bot. Mus. Leafl. Harv. Univ. 11:229. 1944.

Epidendrum radicans Pavon ex Lindl. Gen. & Sp. Orch. Pl. 104. 1831; Ames, Hub. & Schweinf. Genus Epidendrum in U. S. & Mid. Am. 162. 1936.

Epidendrum radicans Pavon var. *chiriquense* Schltr. in Fedde Rep. Sp. Nov. Beih. 17:39. 1922.

Variable terrestrial or epiphytic herbs with stems from about 0.1 to 1 m. long, erect, pendent or sprawling. Stems simple or branched, usually slender and leaf-bearing on the newer growths, provided with long whitish roots which originate opposite the bases of some of the leaves, or rarely without these roots. Leaves 1.5–12 cm. long and 0.6–3.5 cm. broad, ligulate to oval or oblong to ovate, obtuse, fleshy, lax or crowded. Inflorescence a lax to short subumbellate or paniculate raceme borne at the apex of a scape which may be up to 1 m. long; scape slender, terete, covered with scarious, appressed bracts or becoming naked, often branched. Flowers variable in size and color, from red to white but most often brick-red. Dorsal sepal 12–22 mm. long and 4–7 mm. broad, elliptic or oblong to narrowly obovate, acute. Lateral sepals similar but slightly oblique. Petals 12–20 mm. long and 5–8 mm. broad, elliptic to obovate, acute. Lip unguiculate, the claw adnate to the column; lamina 7–17 mm. long and as broad, 3-lobed, suborbicular-cordate in outline; the lateral lobes large, rounded, larger than the mid-lobe, the margins entire or usually lacerate; mid-lobe usually oblong in outline, bilobulate with the lobules slighty divergent, entire or usually lacerate, equalling or exceeding the tips of the lateral lobes in length; disc provided with 2 flattened submammillate calluses at the apex of the column and usually with 2 inconspicuous lamellate calluses extending from the apex of the column toward the apex of the lip.

Mexico to Panama, Venezuela, Colombia, Peru and British Guiana.

BOCAS DEL TORO: without locality, *Wedel 12.* CANAL ZONE: Quebrada Ancha, alt. 770 m., *Dodge & Steyermark 17042;* Barro Colorado Island, *Woodworth & Vestal 703, 705.* CHIRIQUÍ: Volcán de Chiriquí, alt. 2450 m., *Davidson 945;* valley of Río Caldera, alt. 1400–1600 m., *Killip 3517;* Chiriquí, alt. 1000–1200 m., *Powell 61, 3503, 3515;* between Concepción and El Volcán, *Peggy White 314;* Chiriquí Viejo Valley, *Gene White 84;* Finca Lérida to Boquete, alt. 1300–1700 m., *Woodson, Allen & Seibert 1098;* vicinity of Boquete, alt. 1200–1500 m., *Woodson & Schery 797.*

A variable species, both in vegetative and floral structure. Where it occurs it is often exceedingly common.

47. EPIDENDRUM IMATOPHYLLUM Lindl. Gen. & Sp. Orch. Pl. 106. 1831; Ames, Sched. Orch. 4:43, *figs.* 1923.

Epidendrum lorifolium Schltr. in Fedde Rep. Sp. Nov. Beih. 17:35. 1922.

Epiphytic (or terrestrial) herbs occasionally up to about 1 m. long. Stems slender, somewhat weak, arising from a rhizome, covered with the pergameneous leaf-sheaths, becoming naked with age. Leaves 6–20 cm. long and 0.6–3 cm. broad, ligulate to ligulate-lanceolate, acute or obtuse, coriaceous. Inflorescence simple or occasionally branched, a more or less compact raceme borne at the apex of a slender peduncle which may be up to 2 dm. long; flowers rose to purple. Dorsal sepal 13–20 mm. long and 3.5–5 mm. broad, elliptic to elliptic-oblanceolate, acute or acuminate. Lateral sepals similar to the dorsal except oblique. Petals 13–18 mm. long and 6–8 mm. broad, elliptic to elliptic-rhomboid, acute. Lip unguiculate; lamina 7–10 mm. long and 5–9 mm. broad, oblong to oblong-obovate in outline, obscurely 3-lobed or lacerate-dentate, especially toward the base; disc with 2 short submammillate calluses at the apex of the column and with a short lamellate callus between them and extending toward the apex of the lip.

Mexico to Panama, Trinidad, Colombia to Peru, the Guianas and Brazil.

CANAL ZONE: Mojinga swamp, *Allen 867.* PANAMÁ: Sabana, *Pittier 3403;* Tapía River, Juan Díaz region, *Maxon & Harvey 6698;* above Peluca Hydrographic Station, *Hunter & Allen 652;* "Panama", *Powell 138.*

This species usually has its roots inhabited by ants. It is said to deteriorate in cultivation if the ants are exterminated.

48. EPIDENDRUM INCOMPTUM Reichb. f. in Bot. Zeit. 10:733. 1852; Ames in Bot. Mus. Leafl. Harv. Univ. 4:64, *t.* 1936.

Erect or scandent epiphytic herbs up to about 70 cm. long. Stems branched or rarely simple, bearing leaves near the apex of the stem, covered with the amplexicaul leaf-sheaths or naked below. Leaves 3–13 cm. long and 1.5–5.5 cm. broad, narrowly oblong to oblanceolate-acute, coriaceous. Inflorescence a few- to several-flowered terminal raceme, about equal to the subtending leaves; flowers greenish. Dorsal sepal 11–15 mm. long and 3.5–5.5 mm. broad, oblanceolate, acute. Lateral sepals 11–15 mm. long and 4.5–6 mm. broad, semilunate, acute. Petals 11–14 mm. long and 1.5–2 mm. broad, narrowly oblanceolate, acute. Lip unguiculate; claw adnate to the column; lamina 7–9 mm. long and 12–17 mm. broad, fleshy,

Fig. 129. *Epidendrum incomptum*

3-lobed, subreniform in outline, lobes about equal, the laterals divaricate and rounded, the mid-lobe subtriangular; disc without calluses.

Mexico, Guatemala, Costa Rica and Panama.

CHIRIQUÍ: "Chiriquí", *Warscewicz.*

No specimens of this species have been found in Panama since the original was collected.

49. EPIDENDRUM ISOMERUM Schltr. in Fedde Rep. Sp. Nov. 2:132. 1906.

Pendent or repent epiphytic herbs up to 1 m., or perhaps more, long. Stems slender, simple or usually branched, flexuose, bearing leaves toward the apex of the new growths, covered with the chartaceous leaf-sheaths, even when old. Leaves 2–12 cm. long and 0.15–0.4 cm. broad, linear, acute, flat or subterete. Inflorescence a single flower borne at the apex of new growths. Flower small, yellowish. Sepals 11–15 mm. long and 2–3 mm. broad, linear-lanceolate, acute, margins revolute. Petals 11–13 mm. long and 1.2–1.5 mm. broad, elliptic-linear, acute. Lip unguiculate, claw adnate to the column; lamina 8–9 mm. long and 2–2.5 mm. broad, narrowly lanceolate, trulliform or canaliculate, fleshy, acute; disc provided with 2 short inconspicuous calluses at the base and with 1 sublamellate median callus extending from the base to about the middle of the lamina.

Mexico, Guatemala, British Honduras, Costa Rica and Panama.

BOCAS DEL TORO: between Finca St. Louis and Konkintoë, alt. 10–15 m., *Woodson, Allen & Seibert 1886.* CANAL ZONE: Río Medio, *Miller 1746.*

50. EPIDENDRUM LOCKHARTIOIDES Schltr. in Fedde Rep. Sp. Nov. Beih. 19:39. 1923; Ames, Sched. Orch. 8:46, *t. 24.* 1925.

Small, densely caespitose, epiphytic herbs up to about 2.5 dm. tall, usually less. Stems covered with the subequitant bases of the leaves. Leaves 1–3.5 cm. long, laterally compressed, approximate, spreading, cultriform, and the sheathing base subequitant, 5–10 mm. broad. Inflorescence composed of several flowers borne in the axils of the upper (sheath-like) leaves; flowers inconspicuous, greenish-yellow or green. Dorsal sepal 6–7 mm. long and about 3 mm. broad, broadly lanceolate, acute, cucullate. Lateral sepals 6–8 mm. long and 2–3 mm. broad, cucullate, arcuate, lanceolate, prominently keeled along the mid-nerve dorsally, the keel usually denticulate. Petals 4–7 mm. long and 0.5–1 mm. broad, linear, obtuse, slightly arcuate. Lip 5–7 mm. long, unguiculate; claw adnate to the column; lamina 4–5 mm. long and as broad, cordate-orbicular to subquadrate, obtuse, often with a short apicule, mid-nerve callus-thickened.

Costa Rica and Panama.

COCLÉ: El Valle de Antón, alt. 600–1000 m., *Allen 1680, 2296.*

51. EPIDENDRUM MICRODENDRON Reichb. f. in Beitr. Orch. Centr.-Am. 84. 1866.

Pendent or repent epiphytic herbs up to about 70 cm. long. Stems slender, branched, covered with the leaf-sheaths or becoming naked. Leaves 1.5–5 cm. long and 0.3–0.9 cm. broad, linear-ligulate to elliptic-oblong, obtuse and with the apex

obscurely and unequally bilobed. Inflorescence a short terminal subfractiflex raceme of 2–8 flowers; bracts 4–7 mm. long, chartaceous, cucullate, acute. Dorsal sepal 7–10 mm. long and 1.5–3 mm. broad, lanceolate, acute. Lateral sepals 6.5–9 mm. long and 2.5–3 mm. broad, lanceolate to ovate-lanceolate, acute, oblique. Petals 5–10 mm. long and 0.7–1.5 mm. broad, linear to elliptic-linear, acute. Lip unguiculate; the claw short, adnate to the column; lamina 5–8 mm. long, and when expanded about as broad, 3-lobed but obscurely so, the lateral lobes erect, rounded, enfolding the short column, mid-lobe lanceolate or narrowly triangular, acute or acuminate, fleshy, and the apex subterete; disc provided with a small cucullate callus under the apex of the column which is entire or tridentate at the apex. Column provided with a horn-like process at its apex.

Costa Rica and Panama.

CHIRIQUÍ: Cuesta de las Palmas, Serra de la Horqueta, alt. 1700–2100 m., *Pittier 3220*.

The specimen from Panama is not typical—perhaps represents a distinct species.

52. Epidendrum moyobambae Kränzl. in Fedde Rep. Sp. Nov. 1:185. 1905; C. Schweinf. in Bot. Mus. Leafl. Harv. Univ. 11:238. 1944.

Epidendrum subpatens Schltr. in Fedde Rep. Sp. Nov. Beih. 17:40. 1922.
Epidendrum benignum Ames in Sched. Orch. 2:26. 1923.

Pendent or ascending, caespitose, epiphytic herbs up to about 8 dm. long. Stems slender, simple, covered with the leaf-sheaths above, naked at the base. Leaves 6–16 cm. long and 1.5–4 cm. broad, elliptic-lanceolate to elliptic-ovate, acute, coriaceous. Inflorescence a terminal few- to many-flowered pendent raceme up to about 4 dm. long; flowers rather large, greenish to yellowish or whitish. Dorsal sepal 17–25 mm. long and 5–9 mm. broad, oblanceolate, acute or obtuse. Lateral sepals 17–25 mm. long and 5–9 mm. broad, oblanceolate to narrowly obovate, oblique, obtuse. Petals 16–22 mm. long and 3–7 mm. broad, linear-oblanceolate to broadly oblanceolate, obtuse or acute, slightly oblique. Lip unguiculate; the claw adnate to the column; lamina 15–25 mm. long and 20–30 mm. broad, 3-lobed; lateral lobes spreading or deflexed, suborbicular, obtuse, much larger than the mid-lobe; mid-lobe bilobulate, the lobules more or less divaricate, smaller than either lateral lobe; disc provided with 2 small submammillate or mammillate calluses under the apex of the column and with 1 or rarely 3 lamellate calluses extending along or near the median line.

Guatemala, Costa Rica, Panama, Trinidad, Colombia, Peru and Brazil.

CANAL ZONE: Gatún Lake, *Powell 86, 3337, 3558;* Barro Colorado Island, *Shattuck 216*. VERAGUAS: Santiago, alt. 15 m., *Powell 86, 3558*.

Presumably this was originally confused with *Epidendrum patens* Sw. It may prove to be the same. It is a rather showy plant. Powell's numbers for the two localities are the same, and it is possible that all of the material came from one original collection.

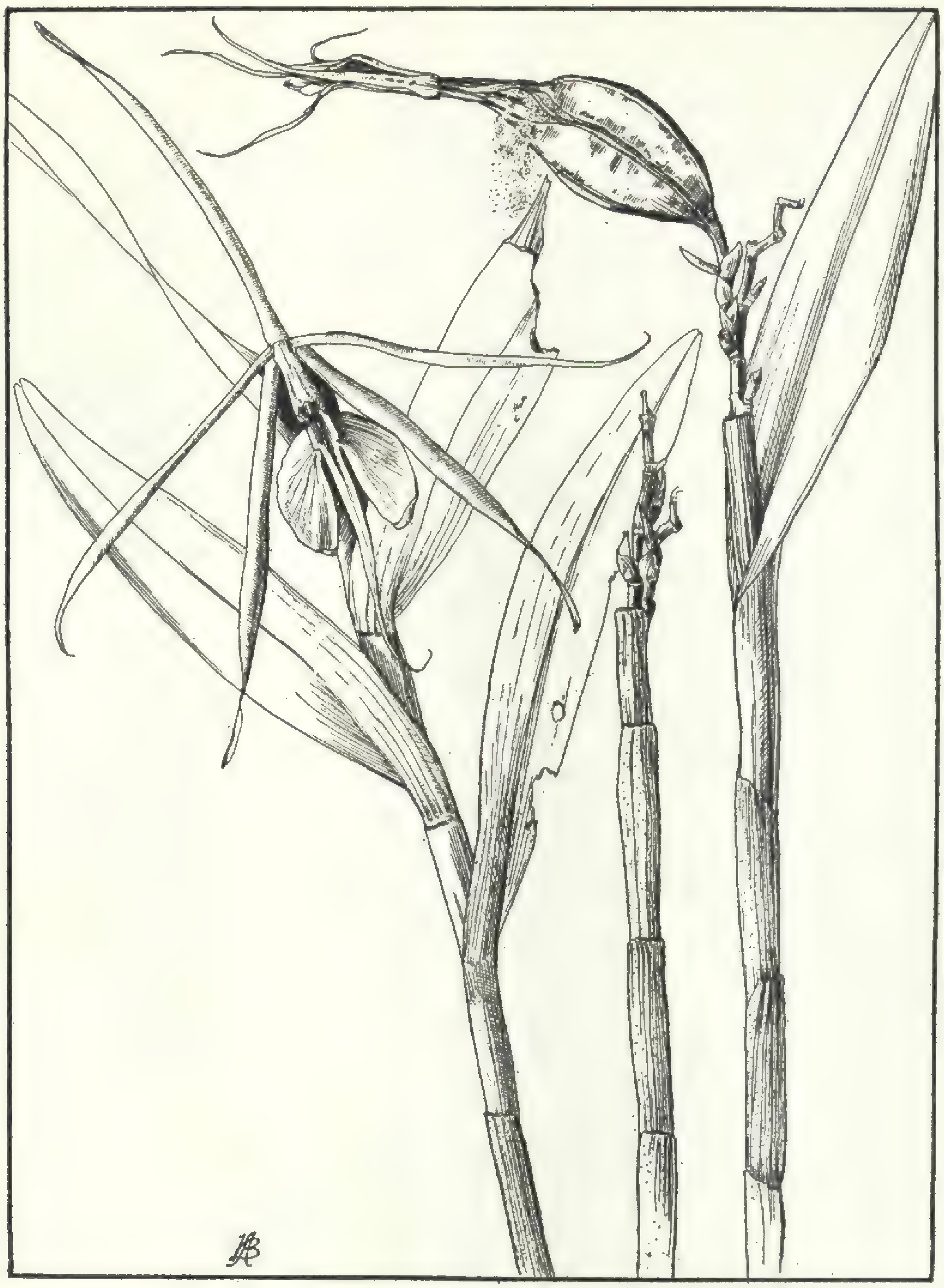

Fig. 130. *Epidendrum nocturnum*

53. Epidendrum nocturnum Jacq. Enum. Pl. Carib. 29. 1760; Select. Stirp. Am. 225, *t. 139*. 1763; Ames, Hub. & Schweinf. Genus Epidendrum in U. S. and Mid. Am. 129. 1936.

Epidendrum nocturnum Jacq. var. *panamense* Schltr. in Fedde Rep. Sp. Nov. Beih. 17:36. 1922.

Variable, caespitose or subrepent, epiphytic plants up to 1 m. tall. Stems slender, simple, covered with the scarious leaf-sheaths or becoming naked. Leaves

5–15 cm. long and 0.8–6.5 cm. broad, elliptic, elliptic-oblong, ligulate or oval, acute or obtuse, coriaceous to fleshy. Inflorescence a 1- to few-flowered terminal raceme (1 flower open at a time); rachis when present fractiflex; flowers large, usually white. Sepals similar, 35–90 mm. long and 2–5 mm. broad, from filiform to linear, acute or acuminate. Petals similar to the sepals but smaller, 35–80 mm. long and 1–3 mm. broad. Lip unguiculate, claw adnate to the column; lamina up to 65 mm. long, prominently 3-lobed; lateral lobes subparallel, acute, oblique, lanciform, 10–40 mm. long; mid-lobe subfiliform, 20–40 mm. long.

Florida, Mexico to Panama, the West Indies and tropical South America.

BOCAS DEL TORO: vicinity of Chiriquí Lagoon, *Wedel 1001, 2938*. CANAL ZONE: hills near Panamá City, Gatún Lake, Frijoles, San Juan, Chorrera, Paja, *Powell 35, 216, 217, 3020, 3055, 3073, 3075*. CHIRIQUÍ: "Chiriquí", alt. 1200–1400 m., *Powell 347*. COCLÉ: hills north of El Valle de Antón, alt. 800–1000 m., *Allen 2257*.

Occasional throughout the American tropics, usually found at low elevations but occasionally in the mountains.

54. EPIDENDRUM OBESUM Ames in Sched. Orch. 2:31. 1923.

Coarse, caespitose, epiphytic herbs up to about 6 dm. tall. Stems slender, covered with the loosely amplexicaul complanate leaf-sheaths or reduced leaves. Leaves 5–20 cm. long and 3–7 cm. broad, elliptic-ligulate to oval, obtuse, usually crowded on the stem. Inflorescence a short, few- to several-flowered raceme subtended by a large spathaceous sheath, the flowers long-pedunculate, whitish. Dorsal sepal 35–55 mm. long and 3–7 mm. broad, linear or linear-elliptic, acute. Lateral sepals similar to the dorsal except slightly arcuate. Petals 28–50 mm. long and 1.5–4 mm. broad, linear, acute. Lip unguiculate; the claw adnate to the column; lamina 18–30 mm. long and up to about 15 mm. broad, 3-lobed; the lateral lobes semiorbicular to subquadrate, explanate, obtuse, about 6–8 mm. long and as broad; mid-lobe about 14–25 mm. long, linear-lanceolate to very narrowly triangular, acute; disc provided with 2 fleshy calluses at the base, the apices of which are free and porrect. Pedicellate ovary up to about 12 cm. long.

Nicaragua, Costa Rica and Panama. Possibly also in Ecuador.

CHIRIQUÍ: Bajo Chorro, Boquete District, alt. 1800 m., *Davidson 1288*.

The flowers somewhat resemble those of *Epidendrum nocturnum* Jacq.

55. EPIDENDRUM PANAMENSE Schltr. in Fedde Rep. 12:212. 1913.

Caespitose epiphytic herbs up to about 2 dm. tall. Stems ancipitous, covered with amplexicaul leaf-sheaths, provided with 2–3 leaves toward the apex. Leaves 8–11 cm. long and 1–1.3 cm. broad, elliptic to lanceolate, acuminate. Inflorescence a compact few-flowered distichous raceme terminating a slender ancipitous peduncle. Sepals about 1.2 cm. long, ligulate, apiculate, the laterals oblique. Petals about as long as the sepals, linear. Lip unguiculate; claw adnate to the column; lamina about 5 mm. long and 4 mm. broad, ovate, shortly acuminate, subcordate at the base, provided with 2 calluses at the base which have a short keel between them. *(Description compiled from the original)*.

Panama.

PANAMÁ: Cerro de Garagará, Sambú Basin, southern Darién, alt. 550–974 m., *Pittier 5635*.

Allied to *Epidendrum Allenii* L. Wms. and to *E. Lankesteri* Ames.

56. EPIDENDRUM PANICULATUM Ruiz & Pavon, Syst. Veg. 243. 1798; Hook. f. in Bot. Mag. 94: *t. 5731*. 1868; Ames, Hub. & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 2:67. 1934.

Epidendrum floribundum HBK. Nov. Gen. & Sp. 1:353, *t. 86*. 1816; Hook. in Bot. Mag. 65: *t. 3637*. 1838.
Epidendrum turialvae Reichb. f. in Gard. Chron. 1871:1678. 1871.
Epidendrum resectum Reichb. f. in Linnaea 41:82. 1877.
Epidendrum piliferum Reichb. f. loc. cit. 83.
Epidendrum Isthmi Schltr. in Fedde Rep. Sp. Nov. Beih. 17:34. 1922.
Epidendrum reflexum Ames & Schweinf. in Sched. Orch. 8:49. 1925.

Caespitose epiphytic or saxicolous plants up to about 1.5 dm. tall, often rank in growth. Stems simple, erect or spreading, covered with the amplexicaul leaf-sheaths or naked with age. Leaves 4–25 cm. long and 0.5–7 cm. broad, variable but essentially linear-lanceolate to oval, acute or acuminate, rarely obtuse, coriaceous. Inflorescence from shorter than the subtending leaves to much longer, from a simple few-flowered raceme to a compound multiflorous panicle, terminal, usually subtended with a spathe which may be up to 6 cm. long; bracts on the peduncle from very short to about 7 cm. long; flowers variable in size and color. Dorsal sepal 7–16 mm. long and 2–3.5 mm. broad, elliptic to broadly oblanceolate, acute or obtuse. Lateral sepals 8–16 mm. long and 2.5–4.5 mm. broad, elliptic to broadly lanceolate, acute or obtuse. Petals 8–15 mm. long and 0.2–2 mm. broad, usually filiform or filiform-clavellate but occasionally linear-oblanceolate. Lip unguiculate; claw adnate to the column; lamina 4–10 mm. long and 5–12 mm. broad, from nearly simple to 3- or 4-lobed (commonly 3-lobed); lateral lobes from dolabriform to obliquely triangular-ovate or ovate, outer margin entire to sublacerate; mid-lobe usually strongly bilobulate, but often from truncate to retuse, often apiculate, lobules variable in form and divergence, linear to oblong to triangular or spatulate, margin entire or somewhat lacerate; disc with 2 short sublamellate calluses at the base, often provided with one or more callus ridges parallel to the mid-nerve.

Mexico to Panama and in South America to Argentina.

CANAL ZONE: Quebrada Ancha, *Steyermark & Allen 17109;* hills east of Panamá City, and Río Indio near the mouth of Chagres River, *Powell 104, 323, 3396*. CHIRIQUÍ: El Boquete, alt. 100–1300 m., *Pittier 2973;* "Chiriquí", *Powell 233, 3174;* Río Chiriquí Viejo, alt. 1300–1900 m., *Seibert 145;* Upper Río Chiriquí Viejo, *White 326*. COCLÉ: vicinity of La Mesa, north of El Valle de Antón, alt. 1000 m., *Allen 2389*. PANAMÁ: Río Tapía, *Standley 28137*.

A widespread and variable species. Only the essential synonymy for Panama and adjacent Costa Rica has been given above.

Fig. 131. *Epidendrum pendens*

57. Epidendrum pendens L. Wms. in Ann. Missouri Bot. Gard. 28:421, *t. 23.* 1941.

Pendent epiphytic herbs about 45 cm. long. Leaves 9–15 cm. long and 2–3.5

cm. broad, elliptic to elliptic-lanceolate, coriaceous, distichous, marginate, gray, deciduous; leaf-sheaths loose, completely investing the stem, pergameneous, ancipitous, the abscission line prominent. Inflorescence of 1 or few large terminal flowers subtended by a leaf-like sheath up to 3 cm. long; flowers large for the genus, green. Dorsal sepal about 5 cm. long and 1.2 cm. broad, oblong-oblanceolate, acute, fleshy, with 5–7 main nerves. Lateral sepals 4.3–4.8 cm. long and 1.5 cm. broad, elliptic, acute, fleshy, with about 7 main nerves. Petals about 4.5–5 cm. long and 2 mm. broad, linear, somewhat narrowed to the base, obtuse or acute, fleshy, 1-nerved. Lip with the claw adnate with the column to the apex of the column; lamina about 2.5–3 cm. long and 3 cm. broad, 3-lobed, suborbicular in general outline, with a thickened central nerve and with thickened nerves or ridges radiating from it and covering the remainder of the lip, lateral lobes rounded, about 1.5 cm. long, mid-lobe 1–1.5 cm. long and about 1.5 cm. broad, subquadrate, emarginate. Column 1.5–2 cm. long and 6–8 mm. in diameter at the apex, fleshy.

Panama.

COCLÉ: vicinity of La Mesa, El Valle de Antón, alt. 1000 m., *Allen 2570*.

58. EPIDENDRUM PHYSODES Reichb. f. in Gard. Chron. 289. 1873.

Small repent or caespitose, epiphytic or terrestrial herbs up to about 30 cm. long. Stems simple, slender, densely leaved, prolonged into a long peduncle above. Leaves 1.5–6.5 cm. long and 0.3–0.8 cm. broad, lanceolate, the margins often revolute. Inflorescence a short few-flowered raceme (with 1 flower open at a time?) on the apex of a long peduncle. Dorsal sepal 5–9 mm. long and 2–3 mm. broad, elliptic to oblong-lanceolate, acute. Lateral sepals 5–9 mm. long and 2.3–3.6 mm broad, elliptic-oblong to oblong-ovate, somewhat oblique, acute. Petals 4.5 mm. long and 0.5–0.8 mm. broad, linear to subfiliform. Lip unguiculate; claw adnate to the column; provided with a spur which is 3–4 mm. long, adnate to the ovary for a part of its length or occasionally for all of its length but usually the obtuse and rounded tip free; lamina 3–5 mm. long and 4–6 mm. broad, entire, subreniform or suborbicular, fleshy; disc with 2 mammillate calluses near the apex of the column and often with a longitudinal callus-thickening along the median line.

Guatemala, Costa Rica and Panama.

BOCAS DEL TORO: vicinity of Chiriquí Lagoon, *Wedel 1126*.

This species is atypical in the genus *Epidendrum* in that it is provided with a distinct spur which apparently originates from the lip. If generically distinct it belongs in Lindley's genus *Physinga*. Suitable material for comparative studies is not available.

59. EPIDENDRUM PLATYSTIGMA Reichb. f. in Beitr. Orch. Centr.-Am. 83. 1866.

Epidendrum ramonianum Schltr. in Fedde Rep. Sp. Nov. Beih. 19:217. 1923.
Epidendrum gibbosum L. Wms. in Ann. Missouri Bot. Gard. 28:420, *t. 21, figs. 7–10.* 1941.

Fig. 132. *Epidendrum platystigma*

Simple or branched, repent, terrestrial or epiphytic herbs up to probably more than 5 dm. tall. Stems covered with the very loose leaf-sheaths or becoming naked and vernicose, up to 15 mm. in diameter. Leaves 2–15 cm. long and 0.5–2.5 cm.

broad, linear-lanceolate or linear-oblong to ligulate, obtuse and often unequally bilobulate at the apex, coriaceous, leaves on the sterile or poorly flowered branches largest, on the heavily flowered branches very small; leaf-sheaths usually somewhat inflated and pergameneous, soon disintegrating. Inflorescences short, few-flowered, terminal, the rachis fractiflex; bracts up to 2 cm. long, scarious, cochleate, acute; flowers greenish or whitish, often marked with red. Dorsal sepal 7–12 mm. long and 4–6 mm. broad, elliptic-oblong, acute. Lateral sepals 7–12 mm. long and 3–7 mm. broad, narrowly obovate to oblong-ovate, obtuse or acute, apiculate or winged dorsally along the mid-nerve. Petals 8–10 mm. long and 3–5 mm. broad, oblanceolate to narrowly obovate, obtuse. Lip 6–12 mm. long and 5–10 mm. broad, broadly oblong to suborbicular or cordate, obtuse or shallowly emarginate, fleshy and tumid along the mid-nerve or with several raised nerves, gibbous at the base, provided with an inconspicuous bi- or trilobate callus under the apex of the column.

Costa Rica and Panama.

CHIRIQUÍ: Volcán de Chiriquí, alt. 2600 m., *Davidson 971;* Casita Alta to Serra Copete, alt. 2300–3300 m., *Woodson & Schery 367.*

60. EPIDENDRUM POLYANTHUM Lindl. Gen. & Sp. Orch. Pl. 106. 1831; Batem. Orch. Mex. & Guat. *t. 34.* 1842.

Epidendrum pergameneum Reichb. f. Beitr. Orch. Centr.-Am. 86. 1866
Epidendrum quinquelobum Schltr. in Fedde Rep. Sp. Nov. Beih. 19:125. 1923.

Caespitose epiphytic herbs, often rank-growing, up to about 1.5 m. tall. Stems erect or ascending, simple, leafy above. Leaves 5–25 cm. long and 0.8–5 cm. broad, from linear to oval or ovate, acute or acuminate, variable. Inflorescence terminal or lateral (i. e. flowers or racemes borne from below a leaf) or both, usually consisting of racemes borne laterally on an elongated peduncle, rarely the racemes branching and becoming paniculate, rarely consisting of a single short terminal raceme; flowers extremely variable in size and coloration. Dorsal sepal 6.5–13 mm. long and 2.5–3.5 mm. broad, oblanceolate, obtuse, papillose externally. Lateral sepals 6.5–16 mm. long and 2.5–5 mm. broad, oblanceolate, obtuse, oblique, papillose externally. Petals 5–12 mm. long and about 0.5 mm. broad, filiform or subfiliform. Lip unguiculate; claw adnate to the column; lamina 4–7 mm. long and 4–7 mm. broad, usually broader than long, 3-lobed or rarely almost entire; the lateral lobes oblong to flabellate, entire or usually undulate, dentate or lacerate; mid-lobe from subquadrate to oblong, retuse or bilobulate, the lobules sometimes explanate; disc provided with 2 mammillate calluses near the apex of the column and with one or more callus-thickened ridges along the median line. Ovary and pedicel usually papillose.

Guatemala, Honduras, Nicaragua, Costa Rica and Panama. Venezuela and Brazil.

CHIRIQUÍ: Bajo Chorro, alt. 1400 m., *Davidson 457.*

A polymorphic species which, however, is usually easy to recognize.

60a. Epidendrum polyanthum Lindl. var. myodes (Reichb. f.) Ames, Hub. & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 3:75. 1935.

Epidendrum myodes Reichb. f. Beitr. Orch. Centr.-Am. 86. 1866.

Similar to the species except the lateral sepals are said to be only 4–6.5 mm. long (6.5–16 mm. long in the species).

Honduras, Costa Rica and Panama.

chiriquí: "Chiriquí", alt. 1200 m., *Powell 188, 242, 3398, 3452, 3464, 3472, 3505.*

61. Epidendrum porpax Reichb. f. in Bonplandia 3:220. 1855.

Epidendrum porphyrophyllum Schltr. in Fedde Rep. Sp. Nov. Beih. 17:37. 1922.

Small, caespitose, epiphytic herbs up to about 8 cm. tall. Stems short, covered with the scarious amplexicaul sheaths of the leaves. Leaves 7–25 mm. long and 2–7 mm. broad, ligulate to lanceolate or oblong-lanceolate, obtuse or acute, fleshy, spreading. Inflorescence consisting of a single flower from the apex of the stem, subtended by a scarious sheath; flowers large for the plant, sepals and petals greenish, lip purple. Dorsal sepal 7–14 mm. long and 2–5 mm. broad, lanceolate to lanceolate-ovate, acute. Lateral sepals 8–14 mm. long and 3–5.5 mm. broad, lanceolate to lanceolate-ovate, acute, adnate at the base to the claw of the lip and to the column for about the length of the column. Petals 7–13 mm. long and 0.5–1.5 mm. broad, linear, obtuse, obscurely ciliolate toward the apex. Lip up to 18 mm. long, unguiculate; claw narrow, adnate to the column; lamina 9–15 mm. long and as broad, suborbicular-cordate, obscurely ciliolate, fleshy, provided with 2 mammillate calluses at the base under the apex of the column.

Mexico, Guatemala, Honduras, Costa Rica, Panama and Venezuela.

canal zone: foothills east of Panamá City, *Powell 183.* chiriquí: "Province of Chiriquí", alt. 1200 m., *Powell 4000.*

62. Epidendrum Powellii Schltr. in Fedde Rep. Sp. Nov. Beih. 17:38. 1922.

Caespitose epiphytic herbs up to about 30 cm. tall. Stems simple, somewhat flexuose, covered with leaf-sheaths and ancipitous. Leaves 3.5–16 cm. long and 0.35–1.2 cm. broad, elliptic-linear, acute. Inflorescence up to about 7 cm. long, a terminal, densely flowered raceme subtended by one or more spathaceous bracts. Flowers small, whitish with pink or orange markings. Dorsal sepal 2.5–3.5 mm. long and 1–1.2 mm. broad, narrowly lanceolate to oblong-oval, acute. Lateral sepals 3–4 mm. long and 1.5–2 mm. broad, oblong-oval to ovate, oblique, acute. Petals 2–3 mm. long and 0.3–0.4 mm. broad, linear, acute. Lip unguiculate; claw adnate to the column; lamina 1.5–3 mm. long and about as broad, 3-lobed; the lateral lobes dolabriform to semiorbicular, entire or crenate or lobulate; mid-lobe ligulate to subtriangular, acute; disc with 2 small calluses at the base.

Panama.

chiriquí: "Chiriquí", alt. 1200 m., *Powell 228, 3445, 3456.* coclé: hills south of El Valle de Antón, alt. 600–800 m., *Allen 2797.*

63. EPIDENDRUM PROBIFLORUM Schltr. in Fedde Rep. Sp. Nov. Beih. 17:39. 1922.

Small, caespitose, epiphytic herbs up to about 15 cm. tall. Stems slender, short, produced into a long peduncle above, bearing 2–3 leaves. Leaves 3–5 cm. long and 0.6–1.2 cm. broad, linear-lanceolate to lanceolate, acute. Inflorescence a few-flowered raceme at the apex of the peduncle; flowers small, purple-brown with a white lip. Dorsal sepal about 5 mm. long and 1.5 mm. broad, lanceolate, acute. Lateral sepals about 4.5 mm. long and 2 mm. broad, ovate-lanceolate, slightly oblique, acute. Petals about 4 mm. long and 1 mm. broad, elliptic, obscurely serrulate, acute. Lip unguiculate; claw adnate to the column; lamina about 3 mm. long and 4 mm. broad, entire, reniform-cordate, acute, fleshy; disc provided with a single sublamellate callus near the middle.

Panama.

CHIRIQUÍ: "Chiriquí", *Powell 250.*

Known to us only by the inadequate specimen cited.

64. EPIDENDRUM PSEUDEPIDENDRUM Reichb. f. Xenia Orch. 1:160, *t. 53.* 1856; Hook. f. in Bot. Mag. 97: *t. 5929.* 1871.

Pseudepidendrum spectabile Reichb. f. in Bot. Zeit. 10:733. 1852, not Focke nor Reichb. f.

Caespitose epiphytic herbs up to about 1 m. tall. Stems slender, simple, leafy above, naked below. Leaves 6–20 cm. long and 1.5–4.5 cm. broad, oblanceolate, acute, coriaceous. Inflorescence 1 or more, 1- to 3-flowered terminal racemes borne on a more or less elongated peduncle, the peduncle covered at the base with several imbricated bracts; flowers relatively large, sepals and petals greenish, lip orange. Dorsal sepal 26–30 mm. long and 3–5 mm. broad, oblanceolate, acute. Lateral sepals 22–32 mm. long and 5–7 mm. broad, oblanceolate, acute, sometimes obtuse. Petals 22–30 mm. long and 2–3 mm. broad, linear-oblanceolate, obtuse. Lip unguiculate; the long claw adnate to the column; lamina 13–17 mm. long and 15–22 mm. broad, retuse, transversely oblong or subquadrate to suborbicular-flabellate, entire (or obscurely 3-lobed), crenulate, dentate or lacerate; disc provided with 2 short lamellate calluses at the apex of the column and a longitudinal 1- to 5-ridged callus-thickening along the median line, from base to apex.

Costa Rica and Panama.

CHIRIQUÍ: "auf Ficus-Bäumen der Cordilleren von Chiriquí", alt. 1200 m., *Warscewicz.*

Apparently one of the prettier Epidendrums occurring in Panama.

65. EPIDENDRUM PUDICUM Ames, Sched. Orch. 6:71, *fig. 10.* 1923.

Small, caespitose, epiphytic herbs up to about 20 cm. tall. Stems slender, obscurely fractiflex, covered with the persistent, pergameneous, amplexicaul leaf-sheaths. Leaves 15–30 mm. long and 1–3 mm. broad, linear, obtuse, fleshy. Inflorescence a 1- to few-flowered subumbel. Dorsal sepal 8–10 mm. long and 1.5–2.5 mm. broad, linear-oblanceolate, acute. Lateral sepals similar to the dorsal but slightly arcuate. Petals about 8 mm. long and nearly 1 mm. broad near the apex. Lip unguiculate; claw adnate to the column; lamina about 5 mm. long and

7 mm. broad, subtriangular-cordate to reniform, obscurely 3-lobed, acute, provided with 2 slightly divergent submammillate calluses at the base.

Panama.

CHIRIQUÍ: Palo Alto, alt. 1360 m., *Powell 319, 3412.*

Closely allied to *Epidendrum difforme* Jacq.

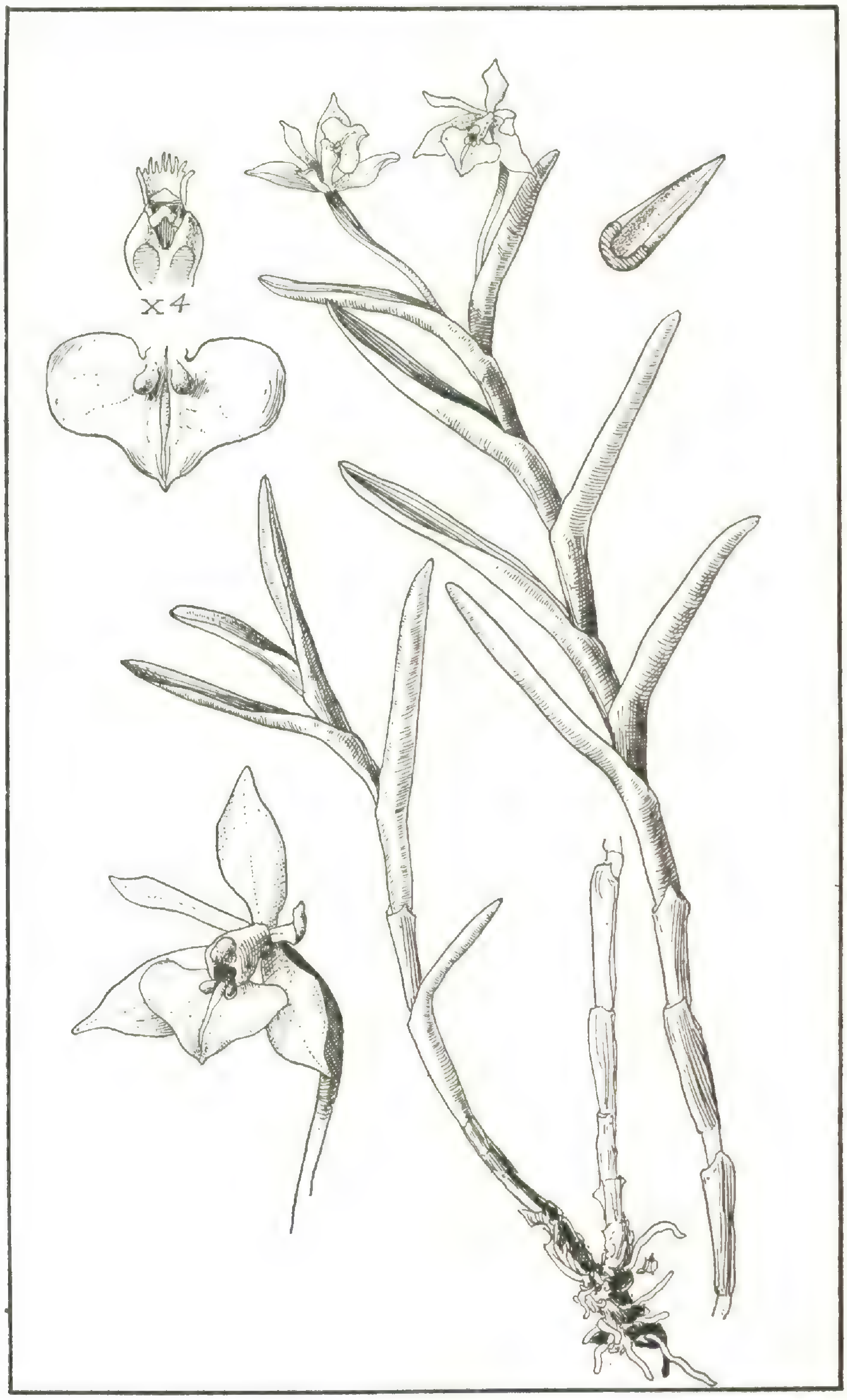

Fig. 133. *Epidendrum pudicum*

66. EPIDENDRUM RAMOSUM Jacq. Enum. Pl. Carib. 29. 1760; Select. Stirp. Am. 221, *t. 132.* 1763; Ames, Hub. & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 2:45. 1934.

Epidendrum flexicaule Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:403. 1918.
Epidendrum modestiflorum Schltr. in Fedde Rep. Sp. Nov. Beih. 19:213. 1923.

Erect or scandent epiphytic herbs, perhaps up to a meter or more long. Stems slender, simple or branched, covered with the leaf-sheaths, becoming naked with age. Leaves 1–12 cm. long and 0.2–1.5 cm. broad, linear to lanceolate to oblong-elliptic, obtuse and the apex usually unequally bilobed. Inflorescence short and few- to several-flowered from a fractiflex raceme; bracts scarious, conspicuous; flowers small, variable in size. Sepals 4.5–13 mm. long and 1.5–3 mm. broad, linear-lanceolate to elliptic-oblong, occasionally carinate dorsally. Petals 4.5–13 mm. long and 0.8–2.3 mm. broad, linear to linear-spatulate, acute or obtuse. Lip unguiculate; claw adnate to the column; lamina 4–9 mm. long and 2–5 mm. broad, simple or subtrilobate, triangular-cordate to lanceolate-cordate, acute or obtuse, provided with a longitudinal callus which is bifurcate at the base.

Mexico to Panama, the West Indies and in South America to Brazil and Peru.

CHIRIQUÍ: Lino Hill, alt. 1550 m., *Powell 322.* COCLÉ: El Valle de Antón, alt. 600–1000 m., *Allen 1244, 2827, 2836.*

66a. EPIDENDRUM RAMOSUM Jacq. var. ANGUSTIFOLIUM (Cogn.) L. Wms. in Ann. Missouri Bot. Gard. 28:422. 1941.

Epidendrum imbricatum Lindl. var. *angustifolium* Cogn. in Mart. Fl. Bras. 3^5:171. 1898, as var. *angustifolia.*
Epidendrum imbricatum Lindl. Gen. & Sp. Orch. Pl. 110. 1831, non Lam.
Epidendrum biflorum Cogn. in Bull. Herb. Boiss. II, 2:337, *figs. 1–3.* 1902, non Forst. f. nec R. & P.
Epidendrum Boissierianum Schltr. in Beih. Bot. Centralbl, 36, Abt. 2:459. 1918.
Epidendrum santaclarense Ames, Sched. Orch. 4:49. 1923.
Epidendrum ramosum Jacq. var. *imbricatum* Ames, Hub. & Schweinf. in Bot. Mus. Leafl. Harv. Univ. 2:47. 1934.

Intergrades with the species but usually varies in having thicker stems, fine maculations on the leaf-sheaths and bracts, the bracts more tightly imbricated and conduplicate; leaves usually broader and larger.

Guatemala, Costa Rica, Panama, the West Indies, Brazil.

BOCAS DEL TORO: Río Cricamola, between Finca St. Louis and Konkintoë, alt. 10–15 m., *Woodson, Allen & Seibert 1898.*

67. EPIDENDRUM REPENS Cogn. in Fedde Rep. Sp. Nov. 7:122. 1909.

Small, repent or pendent, epiphytic herbs up to about 5 dm. long. Stems slender, much branched, leafy, covered with the persistent leaf-sheaths, slightly ancipitous, often flexuose. Leaves 6–25 mm. long and 2–6 mm. broad, linear-oblong to oblong to ovate, obtuse, coriaceous, usually obtuse and obscurely and unequally bilobed at the apex. Inflorescence a single flower borne terminally on the stem, subtended by one or more short scarious bracts; flowers small, inconspicuous, maroon. Dorsal sepal 7–8 mm. long and about 2 mm. broad, elliptic-oblong or

Fig. 134. *Epidendrum rigidum*

lanceolate, acute. Lateral sepals 7–8 mm. long and 1.8–3 mm. broad, elliptic-oblong to lanceolate-ovate, acute. Petals 6–7 mm. long and 0.7–1.5 mm. broad, linear, acute. Lip unguiculate; claw adnate to the column; lamina about 4 mm. long and as broad, triangular-cordate to cordate, simple, fleshy, ecallose or provided with a short, fleshy, lamellate callus toward the apex.

Mexico, Guatemala, Costa Rica, Panama, the West Indies and Venezuela.

CHIRIQUÍ: vicinity of Cerro Punta, alt. 2000 m., *Allen 1530*.

68. EPIDENDRUM RIGIDUM Jacq. Enum. Pl. Carib. 29. 1760; Select. Stirp. Am. 222, *t. 134*. 1763.

Epidendrum cardiophorum Schltr. in Fedde Rep. Sp. Nov. 9:214. 1911.
Spathiger rigidus Small, Fl. Miami, p. 55. 1913.

Repent epiphytic herbs up to about 35 cm. long. Stems slender, simple, covered with the amplexicaul leaf-sheaths, sometimes appearing ancipitous. Leaves 3–13 cm. long and 0.4–2 cm. broad, linear to lanceolate-oblong or oblong, obtuse, coriaceous, the apex usually unequally bilobed. Inflorescence a strict raceme up to about 15 cm. long, few- to several-flowered; bracts up to about 15 mm. long, ovate, acute or obtuse, semi-equitant or usually the base surrounding the peduncle, usually with a median keel which is decurrent onto the peduncle; flowers usually greenish. Dorsal sepal 5.5–9 mm. long and 2–3 mm. broad, oblong to lanceolate-ovate, obtuse. Lateral sepals 5–9 mm. long and 2–4 mm. broad, ovate-lanceolate to obovate, oblique, obtuse. Petals 5–9 mm. long and 1.2–2 mm. broad, ovate-lanceolate to obovate, oblique, obtuse. Lip unguiculate; claw adnate to the column; lamina 4–6 mm. long and about as broad, cordate-orbicular, obtuse or obscurely retuse, lateral margins revolute; disc fleshy, with 2 mammillate calluses at the apex of the column.

Florida, Mexico to Panama, the West Indies, tropical and subtropical South America.

CANAL ZONE: near Salamanca Hydrographic Station, Río Pequení, *Dodge, Steyermark & Allen s. n.*; between Tumba Vieja and Salamanca, *Steyermark & Allen 16749*.

A widespread species which is surprisingly constant in characters.

68a. EPIDENDRUM RIGIDUM Jacq. var. **angustisegmentum** L. Wms. var. nov.[1]

Vegetatively similar to the species. Dorsal sepal 9–10 mm. long and 2–3 mm. broad, lanceolate, acute. Lateral sepals 9–10 mm. long and 2.5–3.5 mm. broad, lanceolate, oblique, acute. Petals 7.5–9 mm. long and 0.5–1 mm. broad, subfiliform to linear, acute. Lip unguiculate; claw adnate to the column; lamina 5–6 mm. long and 3–3.5 mm. broad, oblong-ovate, obtuse, truncate at the base, fleshy; disc with two mammillate calluses at the apex of the column and with one or more inconspicuous callus ridges.

[1]Sepalum dorsale lanceolatum, acutum. Sepala lateralia lanceolata, obliqua, acuta. Petala subfiliformia vel linearia, acuta. Lamina labelli oblongo-ovata, obtusa, basi truncata, carnosa; discus prope basim bicallosus.

Panama.

BOCAS DEL TORO: epiphyte, Nances Cay Island, *Wedel 586;* Water Valley, *Wedel 851;* Water Valley, vicinity of Chiriquí Lagoon, *Wedel 1708* (TYPE Herb. Ames).

The variety differs from the species in its narrower floral segments and differently shaped lip.

69. Epidendrum Sanchoii Ames, Sched. Orch. 4:48. 1923; loc. cit. 10:70. 1930.

Repent epiphytic herbs up to about 4 dm. long. Stems small, branched, often profusely so, usually consisting of a principal stem and smaller elongated branches, covered with the verrucose or rugose amplexicaul leaf-sheaths. Leaves 0.6–8 cm. long and 0.1–0.6 cm. broad, linear or linear-oblong, obtuse, apex usually unequally bilobed. Inflorescence of terminal few-flowered racemes; rachis fractiflex. Dorsal sepal 5–8 mm. long and 1.2–2 mm. broad, lanceolate, acute. Lateral sepals 5–8 mm. long and 1.2–2.5 mm. broad, lanceolate, acute. Petals 4.5–7 mm. long and 0.5–1 mm. broad, linear-elliptic or linear, acute. Lip unguiculate; claw adnate to the column; lamina 3.5–5 mm. long and 2–2.5 mm. broad, triangular-cordate or narrowly so, fleshy, the basal auricles usually erect; the disc appearing excavated, provided with a small trilobulate callus at the base.

Costa Rica and Panama.

CHIRIQUÍ: rain forest, Boquete District, alt. 1800 m., *Davidson 114, 348.*

70. Epidendrum Schlechterianum Ames, Sched. Orch. 7:9, *fig. 1.* 1924.

Nanodes discolor Lindl. in Bot. Reg. 18: *t. 1541.* 1832, non *Epidendrum discolor* Rich. & Gal.

Epidendrum brevicaule Schltr. in Fedde Rep. Sp. Nov. Beih. 17:30. 1922, non Schltr. 1921.

Epidendrum congestoides Ames & Schweinf. Sched. Orch. 10:61. 1930.

Dwarf, densely caespitose herbs up to 8 cm. tall. Stems short, covered with the equitant bases of the leaves. Leaves 1–3 cm. long and 0.2–1 cm. broad, linear-oblong to oblong-oval, obtuse, approximate, semi-equitant, spreading, fleshy. Inflorescence of 1 to few sessile flowers in the axils of the terminal leaves, shorter than the leaves to slightly exceeding them; flowers large for the plant. Dorsal sepal 8–20 mm. long and 3–4.5 mm. broad, lanceolate to oblanceolate, acute or acuminate. Lateral sepals 8–18 mm. long and 2–4.5 mm. broad, lanceolate to ovate-lanceolate, oblique, acute, serrulate-keeled along the mid-nerve dorsally, connate at the base with the claw of the lip. Petals 8–18 mm. long and 1–2.5 mm. broad, elliptic-linear to linear-lanceolate, entire or denticulate, acute. Lip 8–20 mm. long, long-unguiculate; claw adnate to the column, usually slightly longer than the column; lamina 4–8 mm. long and as broad, suborbicular-reniform to oblong-quadrate, apiculate, lobes more or less erect, fleshy. Clinandrium fimbriate-denticulate.

Mexico to Panama, Jamaica, Surinam, Brazil and Peru.

CANAL ZONE: near Vigia and San Juan, *Dodge, Steyermark & Allen 16562;* Río Azote Caballo, 66–70 m., *Dodge, Steyermark & Allen 16864;* San Juan, *Powell 18, 3465.*

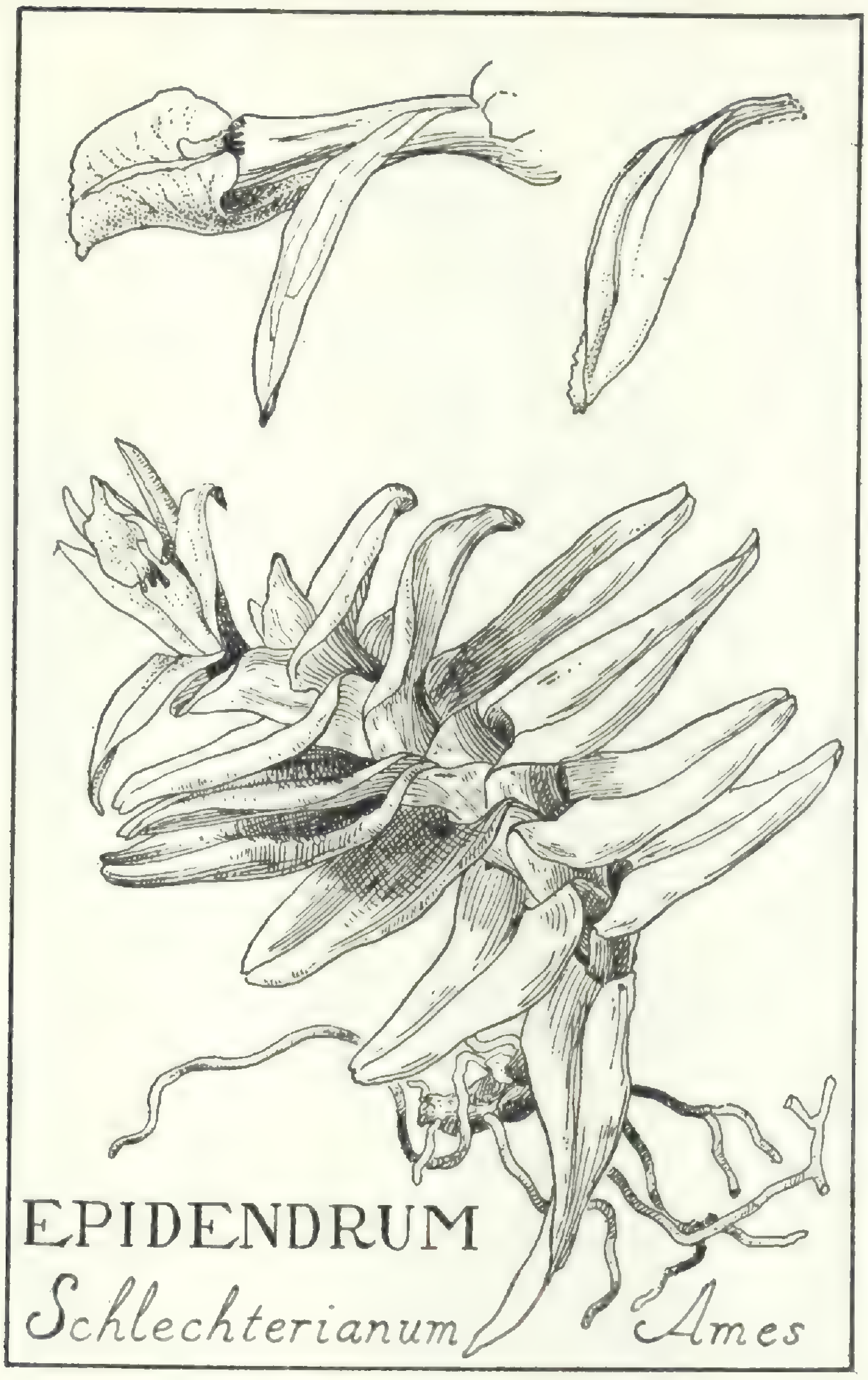

Fig. 135. *Epidendrum Schlechterianum*

71. Epidendrum Schumannianum Schltr. in Fedde Rep. Sp. Nov. 9:215. 1911; Allen in Am. Orch. Soc. Bull. 10:359, *figs*. 1942.

Tall, caespitose, epiphytic herbs up to a meter or more long. Stems up to about 8 mm. in diameter, leafy above, covered with the maculate or verrucose leaf-sheaths, becoming naked and vernicose with age. Leaves 1.5–9 cm. long and 1–3.5 cm. broad, lanceolate to elliptic-oblong, obtuse or acutish, coriaceous. Inflorescence simple or usually a lax many-flowered panicle. Flowers multicolored and rather pretty. Dorsal sepal 8–12 mm. long and 3.5–4.5 mm. broad, oval to broadly oblanceolate, obtuse or acutish. Lateral sepals 8–12 mm. long and 3.5–5 mm. broad, oblanceolate to oval, obtuse or acute, oblique. Petals 8–15 mm. long and 5.5–8 mm. broad, obovate or obovate-spatulate, obtuse. Lip unguiculate; claw adnate to the basal half of the column; lamina 9–15 mm. long and 7.5–12

mm. broad, 3-lobed; the lateral lobes small, oblong, obtuse, explanate; terminal lobe obovate-cuneate, bilobulate or deeply bifid, anterior margins entire to crenulate; disc provided with 2 small submammillate calluses at the base and with 1–3 longitudinal callus-thickenings.

Costa Rica and Panama.

COCLÉ: hills north of El Valle de Antón, vicinity of La Mesa, alt. 1000 m., *Allen 2351, 2386;* El Valle, alt. 670 m., *Dudak s. n.*

72. EPIDENDRUM SCULPTUM Reichb. f. in Bonplandia 2:89. 1854.

Epidendrum colonense Ames, Sched. Orch. 1:14. 1922.

Pendent or repent epiphytic herbs up to about 50 cm. long. Stems simple or branched, densely leaved, covered with the chartaceous leaf-sheaths or becoming naked with age. Leaves 2–4.5 cm. long and 1–1.8 cm. broad, oblong or oblong-lanceolate, obtuse, retuse, coriaceous. Inflorescence with 1–3, usually 2, terminal flowers subtended by spathaceous bracts; flowers green or greenish-yellow. Dorsal sepal 10–14 mm. long and 2.5–3 mm. broad, lanceolate to oblong-lanceolate, obtuse. Lateral sepals 10–15 mm. long and about 3 mm. broad, oblong-lanceolate, oblique, acute. Petals 9–14 mm. long and 2–3 mm. broad, elliptic-linear to narrowly oblanceolate, oblique, obtuse. Lip unguiculate; claw adnate to the column; lamina 9–13 mm. long and 5.5–7 mm. broad, lanceolate-ovate, acute, 3-lobed; lateral lobes small, rounded, reaching to about the middle of the lip; mid-lobe lanceolate; disc provided with two callus-like thickenings at the base on the lateral lobes and with two longitudinal ridges along the median line and reaching to about the middle of the lip.

Possibly Honduras and Costa Rica. Panama, British and Dutch Guiana.

CANAL ZONE: near Vigia and San Juan, *Dodge, Steyermark & Allen 16583;* Gatún Lake, *Powell 116, 3407, 3410;* between Fort Clayton and Corozal, *Standley 29099.* COLÓN: Río Indio de Fato, *Pittier 4265.*

A specimen from Costa Rica, presumed to be this species, has an entire lip.

73. EPIDENDRUM STROBILIFERUM Reichb. f. in Nederl. Kruidk. Arch. 4:333. 1859

Epidendrum verecundum Schltr. in Fedde Rep. Sp. Nov. Beih. 17:42. 1922.
Spathiger strobiliferus Small, Man. Southeast. Fl. 390. 1933.

Small, repent or caespitose, epiphytic herbs up to about 2 dm. long. Stems slender, simple or branched, covered with amplexicaul leaf-sheaths. Leaves 8–45 mm. long and 2–10 mm. broad, from ligulate to elliptic-linear to linear-lanceolate, obtuse or acute, coriaceous, apex usually unequally bilobed. Inflorescence short, few-flowered, flexuose; bracts 5–8 mm. long, cucullate, obtuse, chartaceous; flowers small, inconspicuous. Dorsal sepal 3.5–5 mm. long and 1.2–1.5 mm. broad, linear-lanceolate, acute. Lateral sepals 3.5–5 mm. long and 1.8–2 mm. broad, ovate-lanceolate, oblique, acute. Petals 3–4.5 mm. long and 0.5–1 mm. broad, linear-oblanceolate, obtuse or acute. Lip 3–3.5 mm. long and 1.5–3 mm. broad, lanceolate-cordate to ovate-cordate, acute, ecallose. Ovary with a small

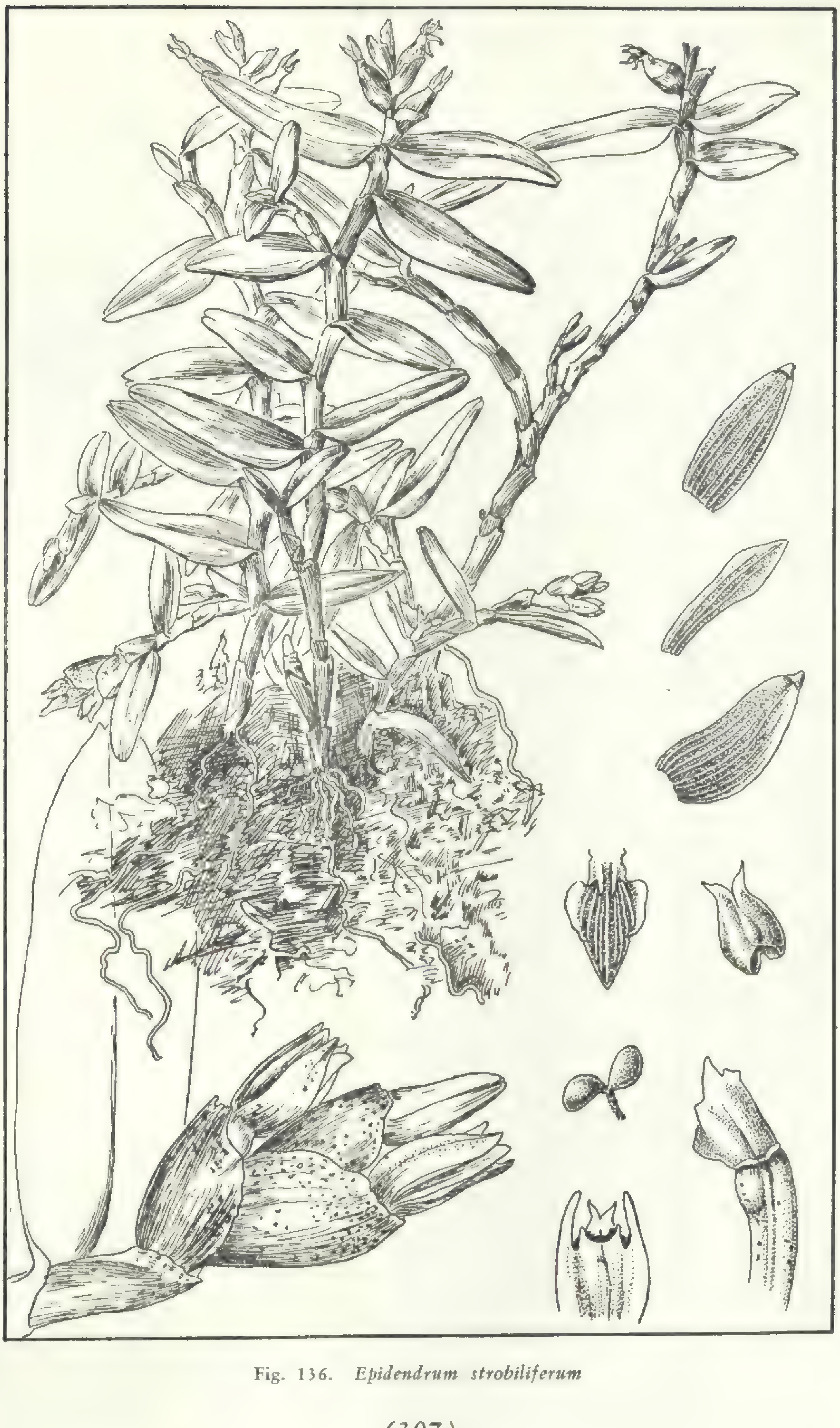

Fig. 136. *Epidendrum strobiliferum*

subscrotiform sac at the apex near the attachment of the lip.

Florida, Mexico to Panama, the West Indies, Venezuela, the Guianas, Brazil and Peru.

CANAL ZONE: foothills east of Panamá City, San Juan Range, and San Juan, *Powell 209, 350, 3435, 3453*; near Summit, *Standley 25747*. PANAMÁ: Río Tecúmen, north of Chepo Road, alt. 30 m., *Hunter & Allen 224*.

74. Epidendrum subnutans Ames & Schweinf. in Sched. Orch. 10:73. 1930.

Caespitose, epiphytic herbs up to about 85 cm. tall. Stems slender, simple, covered with the amplexicaul leaf-sheaths, naked below. Leaves 4.5–18 cm. long and 0.8–4 cm. broad, elliptic-lanceolate to oval or ovate, acuminate or acute. Inflorescence terminal, paniculate, many-flowered; flowers relatively small. Dorsal sepal 5–6 mm. long and 1.2–2 mm. broad, oblanceolate, acute, sometimes papillose dorsally. Lateral sepals 5–6 mm. long and 1.7–2 mm. broad, oblanceolate to elliptic-oblanceolate, oblique, sometimes papillose dorsally. Petals 4–5 mm. long and 0.1–0.5 mm. broad, filiform to narrowly linear-oblanceolate, obtuse. Lip unguiculate; claw adnate to the column; lamina 2.5–3.5 mm. long and 4.5–5.5 mm. broad, 3-lobed, subreniform in outline; lateral lobes explanate, larger than the terminal lobe, dolabriform, margins crenate or undulate; mid-lobe subquadrate, retuse and with erect to spreading lobules; disc provided with a large oval central callus made up of 3 parallel ridges, the middle one extending to the apex of the lip.

Costa Rica and Panama.

CHIRIQUÍ: Bajo Chorro, Boquete District, alt. 1800 m., *Davidson 43, 113*; "Chiriquí", *Powell 428*; vicinity of Bajo Mona and Quebrada Chiquero, alt. 1500 m., *Woodson & Schery 535, 541, 554*; Bajo Chorro, alt. 1900 m., *Woodson & Schery 648*.

Very closely allied to *Epidendrum paniculatum* Ruiz & Pavon, of which it may be but a small-flowered variety.

75. Epidendrum teretifolium Sw. Nov. Gen. & Sp. Prodr. 121. 1788.

Epidendrum teres Reichb. f. in Bonplandia 3:220. 1855, non Thunb.
Epidendrum teretifolium Sw. var. *Powellianum* Schltr. in Fedde Rep. Sp. Nov. Beih. 17:41. 1922.

Caespitose or subrepent, epiphytic herbs up to about 35 cm. tall. Stems slender, simple, erect or ascending, covered with the amplexicaul leaf-sheaths, even in age. Inflorescence a single flower or a few-flowered fascicle borne on the apex of a peduncle which is up to about 8 cm. long, and subtended by chartaceous sheaths and 1 or 2 terminal leaves which are borne near the apex of the peduncle; the peduncle more or less ancipitous; flowers greenish or yellowish, segments fleshy. Dorsal sepal 8–10 mm. long and about 2 mm. broad, linear-lanceolate, acute. Lateral sepals 8–11 mm. long and 1.5–2 mm. broad, elliptic to lanceolate, slightly oblique, acute. Petals 4–6 mm. long and 1.2–1.5 mm. broad, oblanceolate, obtuse, the apex fleshy and thickened. Lip unguiculate; claw adnate to the basal part of the column; lamina 6–8 mm. long and 1–2 mm. broad, 3-lobed, elliptic; lateral

lobes small, rounded, erect, at about the middle of the lip; terminal lobe with a prominent lamellate callus which is higher than the lobe is broad, acute; disc provided with a small lamellate callus toward the base and a large one on the terminal lobe.

Mexico, Guatemala, Honduras, Nicaragua, Panama, the West Indies and Venezuela.

CHIRIQUÍ: Palo Alto, alt. 1200–1400 m., *Powell 240*.

76. EPIDENDRUM TETRACEROS Reichb. f. in Bot. Zeit. 10:733. 1852.

Much-branched epiphytic herbs, probably up to a meter or more long. Stems slender, covered with the scarious leaf-sheath bases when young, becoming naked with age, bearing leaves toward the ends of the stems. Leaves 3–7 cm. long and 0.2–0.8 cm. broad, linear to linear-lanceolate, acute. Inflorescence a few-flowered raceme, about as long as or shorter than the subtending leaves. Flowers with sepals and petals greenish, the lip white with purple-red markings. Dorsal sepal about 12–16 mm. long and 4–5 mm. broad, elliptic-lanceolate, acute or acuminate. Lateral sepals similar to the dorsal but slightly oblique. Petals 12–14 mm. long and 3–5 mm. broad, linear-oblanceolate, acute. Lip unguiculate; claw adnate to the column; lamina 10–12 mm. long and 11–14 mm. broad, fleshy, suborbicular, undulate-crenate, provided with 2 small lamellate calluses under the apex of the column (hidden by the clinandrium) and a large, thick, central callus made up of 3 or more ridges. Column winged laterally at the apex and with two apical stelidiar arms above the clinandrium.

Costa Rica and Panama.

CHIRIQUÍ: "Chiriquí", *Warscewicz;* near El Boquete, *Pittier 3115*.

77. EPIDENDRUM TRACHYTHECE Schltr. in Fedde Rep. Sp. Nov. 3:249. 1907.

Small, caespitose or repent, epiphytic herbs up to about 25 cm. long. Stems slender, leafy, simple or usually much branched, covered with the verrucose or rugose amplexicaul leaf-sheaths. Leaves 1–4.5 cm. long and 0.3–0.5 cm. broad, ligulate, obtuse, the apex retuse and unequally bilobed. Inflorescence short, a single flower, or usually a few-flowered flexuose raceme exceeded by the subtending leaves; bracts up to about 5 mm. long, chartaceous, cucullate, oblong to ovate. Flowers small, inconspicuous, greenish-yellow to white. Dorsal sepal 3–3.5 mm. long and 1.5–2 mm. broad, oblong to oval, obtuse or acute. Lateral sepals 3–3.5 mm. long and 2.2–3 mm. broad, oblong-ovate to suborbicular, slightly oblique, acute or obtuse. Petals 3–3.2 mm. long and 0.7–0.8 mm. broad, linear-oblong to oblanceolate, acute or obtuse. Lip unguiculate; claw adnate to the lower ⅔ of the column; lamina 2–2.5 mm. long and 3–3.5 mm. broad, transversely oval to subreniform, often short-apiculate; disc provided with a bilobate submammillate callus near the middle, the lobes sometimes somewhat separated.

Guatemala, Costa Rica and Panama.

CHIRIQUÍ: Bajo Chorro, Boquete District, alt. 1800 m., *Davidson 124*.

78. Epidendrum triangulabium Ames & Schweinf. in Sched. Orch. 10:75 1930.

Small, caespitose or repent, epiphytic herbs up to about 20 cm. long. Stems slender, simple or branched, covered with the loose, keeled, amplexicaul leaf-sheaths, naked with age. Leaves 1.3–2.5 cm. long and 0.5–1.2 cm. broad, elliptic to oval, obtuse, coriaceous, apex obscurely bilobed. Inflorescence a single terminal or lateral flower. Flowers apparently cleistogamous. Dorsal sepal about 12 mm. long and 3 mm. broad, lanceolate, acute. Lateral sepals about 12 mm. long and 3 mm. broad, lanceolate, acute, oblique. Petals about 12 mm. long and 2 mm. broad, elliptic, acute, oblique. Lip unguiculate; claw adnate to the column; lamina about 6 mm. long and 9 mm. broad, sagittate-triangular, the apex of the lateral extensions and the terminal point acute.

Costa Rica and Panama.

coclé: vicinity of El Valle de Antón, alt. 600–1000 m., *Allen 1245*. ?panamá: near top of Cerro Campana, alt. 800–1000 m., *Allen 2223*.

We have seen no completely satisfactory material of this species.

79. Epidendrum Warszewiczii Reichb. f. in Bot. Zeit. 10:732. 1852; in Xenia Orch. 1:69, *t. 26.* 1854.

Small, erect, epiphytic herbs with relatively large flowers. Stem slender, few-leaved. Leaves (about 12–15 mm. long?) linear-ligulate, obtuse, apex bilobed. Inflorescence reflexed, many-flowered (illustration shows five). Perianth segments oblong, acute (in illustration apparently lanceolate, acute or acuminate); lip dilated in front, minutely denticulate, 3-lobulate (illustration shows: about 30 mm. long and 17 mm. broad, this presumed to be natural size, obovate, obscurely 3-lobed, denticulate margins); disc with 2 erect teeth (calluses) at the base and 3 elevated longitudinal lines.

Costa Rica and Panama according to Warscewicz.

panamá: "Costa Rica, Veraguas, Chiriqui", *Warscewicz.*

The collection locality of the single specimen known to exist was given by Reichenbach, in the second publication cited, as we have shown it. The description was taken from the original publication and from the plate cited.

80. Epidendrum lividum Lindl. in Bot. Reg. 24: Misc. p. 51. 1838; Ames, Hub. & Schweinf. Genus Epidendrum in U. S. & Mid. Am. 118. 1936.

Costa Rica, Venezuela and Colombia. Reported from Panama in cultivation.

28. DIACRIUM Lindl. ex Benth.

Diacrium Lindl. ex Benth. in Jour. Linn. Soc. Lond. 18:312. 1881; Benth. & Hook. Gen. Pl. 3:526. 1883; Pfitzer in Engler & Prantl, Nat. Pflanzenf. II, 6:146. 1888.

Epidendrum subg. *Diacrium* Lindl. in Hook. Jour. Bot. 3:81. 1841.

Caespitose epiphytic or semi-epiphytic herbs. Stems pseudobulbose, solid or hollowed by insect action. Leaves at or near the apex of the pseudobulbs, few.

Fig. 137. *Diacrium bilamellatum*

Inflorescence terminal, racemose, borne at the end of an elongated peduncle, few- to several-flowered. Sepals similar, free, spreading. Petals similar to the sepals. Lip free from the column and spreading, 3-lobed, provided with two horn-like processes toward the base which are hollow and open from the underside of the lip. Column short, footless, produced laterally into wings. Anther terminal, operculate, incumbent, 2-celled, the cells divided by a longitudinal septum; pollinia 4, laterally compressed, each one provided with a granular, viscid appendage.

Diacrium is closely allied to *Epidendrum,* from which it is easily, if superficially, distinguished by the hollow horn-like processes on the lip. A small genus of four or five species.

1. Diacrium bilamellatum (Reichb. f.) Hemsl. in Godm. & Salvin, Biol. Centr.-Am. Bot. 3:222. 1883.

Epidendrum bilamellatum Reichb. f. in Walp. Ann. 6:345. 1862.
Diacrium bilamellatum var. *Reichenbachianum* Schltr. in Fedde Rep. Sp. Nov. Beih. 17:47, in text. 1922.

Coarse, caespitose, epiphytic herbs up to about 60 cm. tall. Stems swollen, solid or hollowed by insects, cylindric to fusiform, provided with 1–4 leaves at the apex. Leaves 6–20 cm. long and 0.6–2.5 cm. broad, ligulate to ligulate-lanceolate, obtuse, fleshy. Inflorescence a short several-flowered raceme borne near the top of an elongated peduncle; peduncle up to 45 cm. long, provided with amplexicaul, chartaceous sheaths. Flowers pedicellate, one or few open at one time, perhaps often cleistogamous. Dorsal sepal 12–15 mm. long and about 6 mm. broad, oval, acute. Lateral sepals 11–16 mm. long and 5–6 mm. broad, elliptic-oval to lanceolate-ovate, acute. Petals 11–14 mm. long and 7–8 mm. broad, broadly obovate, short-unguiculate, acute. Lip free from the column and spreading; lamina 11–14 mm. long and 4–6 mm. broad, lanceolate-ovate in outline, 3-lobed, the lateral lobes small and often obscure above the middle of the lip, apices rounded; disc provided with two large lamellate horn-like processes near the middle, these processes hollow, 2–4 mm. high.

Guatemala, British Honduras, Costa Rica, Panama and Venezuela.

bocas del toro: vicinity of Chiriquí Lagoon, *Wedel 2100*. canal zone: Chagres, *Behr;* open woods east of Panamá City, *Powell 67;* Culebra, *Pittier 3406*. panamá: swamp between El Jagua Hunting Club on Río Jagua and El Congor Hill, *Hunter & Allen 473;* San José and Trapeche Islands, Pearl Islands, *Miller 1890, 1909*. without localities: *Ames s. n.; Cowell 160; Johnston 703; Killip 3394*.

This species is said to have its stems often inhabited by ants. It is a lowland, coastal species.

29. CATTLEYA Lindl.

Cattleya Lindl. Collect. Bot. *t. 33 & t. 37*. 1824.

Epiphytic herbs with thick, fleshy or pseudobulbose stems, 1- to 2-foliate at the apex. Leaves coriaceous or fleshy, most often thick. Inflorescence terminal, usually subtended by a spathaceous bract; raceme simple; flowers often large and showy, usually few. Sepals subequal, free. Petals usually broader than the sepals. Lip sessile, broad, erect, free from or slightly adnate to the column, sides erect and usually enfolding the column. Column long, wingless, often somewhat arcuate; anther terminal, operculate, incumbent, each cell with a longitudinal septum; pollinia 4, parallel, ceraceous, broad, somewhat compressed.

One variety in Panama, about 30 in Central and South America. *Cattleya* is the most widely cultivated of the orchids. It hybridizes easily with *Laelia, Brassavola* and *Sophronitis* and the hybrid genera formed by these crosses.

Fig. 138. *Cattleya Skinneri* var. *autumnalis*

1. Cattleya Skinneri Batem. var. autumnalis Allen in Ann. Missouri Bot. Gard. 29:345. 1942.

Epiphytic or semi-terrestrial herbs up to 4 dm. tall. Pseudobulbs 15–30 cm. long and 1–3 cm. in diameter, cylindric to fusiform, 2-, rarely 1-, leaved. Inflorescence a simple few-flowered raceme; spathe 5–10 cm. long, pergameneous. Leaves 10–15 cm. long and 3.5–5.5 cm. broad, elliptic to oblong-lanceolate, obtuse, coriaceous. Sepals 3–5 cm. long and 0.8–1.4 cm. broad, elliptic to broadly oblanceolate, acute. Petals 3–5 cm. long and 1–2.5 cm. broad, lanceolate to narrowly ovate or oval, obtuse or acute. Lip 3–4.5 cm. long and 2–3 cm. broad, oval to obovate, retuse, usually darker in color than the sepals and petals, enfolding the column.

Panama.

PANAMÁ: vicinity of Bejuca, alt. 15 m., *Allen 2668;* east of city, *Powell 16.* CANAL ZONE: Cañon Quebrada, *Pittier 6828.*

The Panamanian variety of a species distributed from Mexico to Costa Rica and the only known *Cattleya* in Panama. Autumn flowering, and the flowers smaller than in the species.

30. LAELIA Lindl.

LAELIA Lindl. Gen. & Sp. Orch. Pl. 115. 1831; Benth. & Hook. Gen. Pl. 3:533. 1883; L. Wms. in Darwiniana 5:74. 1941.

Schomburgkia Lindl. Sert. Orch. *t. 10.* 1838.

Epiphytic herbs often with showy flowers and ancipitous, terete, solid or hollow pseudobulbs. Sepals subequal, free, spreading, flat or undulate. Petals similar to the sepals, sometimes broader. Lip free from or slightly connate with the column, 3-lobed (or nearly simple), the lateral lobes enfolding the column or more or less explanate; disc smooth or lamellate; column long or short, winged or wingless. Anther operculate, incumbent, each cell divided into two by a septum and with each cell sometimes again divided by a more or less perfect septum; pollinia 8, 4 in each cell of the anther, ovate or compressed laterally, ceraceous.

The genus is to be found rather widely over tropical and subtropical America, where it is often exceedingly abundant. Some species are prized by orchid growers and are useful in hybridization. There are about 50 species in the genus.

a. Pseudobulbs less than 8 cm. long; sepals and petals plane .... 1. L. RUBESCENS
aa. Pseudobulbs more than 18 cm. long; sepals and petals undulated or twisted.......... 2. L. LUEDDEMANII

1. LAELIA RUBESCENS Lindl. in Bot. Reg. 26: Misc. p. 20, *t. 41.* 1840.

Laelia peduncularis Lindl. loc. cit. 28: Misc. p. 9. 1842.

Caespitose epiphytic herbs up to 60 cm. tall. Pseudobulbs 1.5–7 cm. long and 1.5–4 cm. broad, oval to orbicular, ancipitous, 1-, rarely 2-, leaved. Leaves 4–20 cm. long and 2–4.5 cm. broad, elliptic, elliptic-lanceolate to ovate, obtuse, coriaceous. Inflorescence a long-pedunculate, few- to several-flowered raceme, terminal or rarely appearing laterally on undeveloped bulbs; bracts up to 1 cm. long, chartaceous, cucullate; flowers small to fairly large, white, or white with the base of the lip lavender to pink, or lavender throughout. Sepals 2–4.5 cm. long and 0.2–0.7 cm. broad, linear-lanceolate to elliptic, obtuse or acutish. Petals 2–4.5 cm. long and 0.3–1.5 cm. broad, elliptic or lanceolate, obtuse or acute. Lip 1.5–3.5 cm. long and up to 1.5 cm. broad, shorter than the sepals and petals, 3-lobed, provided with several inconspicuous longitudinal ridges; lateral lobes short, rounded and obtuse, enfolding the column; terminal lobe oblong-oval, blunt or retuse.

Mexico, Guatemala, Salvador, Nicaragua, Costa Rica and Panama.

CHIRIQUÍ: "N. W. corner of Chiriquí, near the Gulf of Dulce," cultivated by *Powell 64.*

Fig. 139. *Laelia rubescens*
(Flowers of species are normally resupinate)

2. Laelia Lueddemanii (Prill.) L. Wms. in Ann. Missouri Bot. Gard. 27:282. 1940.

Schomburgkia Lueddemanii Prill. in Jour. Soc. Imp. Hort. Paris 8:275. 1862; Rolfe in Bot. Mag. 138: *t. 8427*. 1912.

Large, caespitose, epiphytic herbs up to a meter or more tall when in flower. Pseudobulbs 18–30 cm. long and 2–3 cm. broad, apparently somewhat ancipitous, largest toward the top, bifoliate. Leaves 20–35 cm. long and 4–6.5 cm. broad, lanceolate or elliptic, obtuse, coriaceous. Inflorescence a long-pedunculate, several-

to many-flowered raceme up to 75 cm. or more long; bracts up to 6 cm. long, linear to linear-lanceolate; flowers brown or maroon with a purple lip, medium-sized, long-pedunculate. Sepals and petals 2.5–5.5 cm. long, undulated, linear or spatulate, obtuse or acutish. Lip 1.3–2 cm. long and 1–1.3 cm. broad, 3-lobed, with 3 or more inconspicuous longitudinal carinae; lateral lobes rounded, obtuse, appressed to the column; terminal lobe orbicular-ovate, acute, recurved.

Costa Rica, Panama and possibly Venezuela.

CHIRIQUÍ: near city of David, at sea-level, *Powell 170.* COCLÉ: mountains beyond La Pintada, alt. 400–600 m., *Hunter & Allen 509.*

Laelia tibicinis (Batem.) L. Wms., in Darwiniana 5:77. 1941, has been reported from Panama but we have seen no specimens nor authentic record of it from the country.

31. BRASSAVOLA R. Br.

BRASSAVOLA R. Br. in Aiton, Hort. Kew., ed. 2, 5:216. 1813.

Epiphytic herbs with more or less thickened, 1- to 2-leaved stems. Sepals free, equal, spreading, linear or linear-lanceolate, often long and acuminate. Petals similar to the sepals. Lip sessile, erect, more or less enfolding the column, base short or long and narrow, expanded into a broad lamina which is plane, rarely concave or somewhat cucullate. Column erect, usually shorter than the claw of the lip, more or less bialate, footless; anther operculate, incumbent, each cell with an obscure longitudinal septum; pollinia 8, 4 in each cell of the anther, broadly ovate and laterally compressed, ceraceous.

A genus of about 15 species. Flowers often large and showy.

a. Flowering scapes subtended by a leaf, often as long as or longer than the leaf; inflorescence usually several-flowered .... 1. B. NODOSA
aa. Flowering scape from the rhizome, not subtended by a leaf; inflorescence usually 1-flowered .... 2. B. ACAULIS

1. BRASSAVOLA NODOSA (L.) Lindl. Gen. & Sp. Orch. Pl. 114. 1831; in Bot. Reg. 17: *t. 1465.* 1832.

Epidendrum nodosum L. Sp. Pl. 953. 1753.
Brassavola venosa Lindl. in Bot. Reg. 26: Misc. p. 20. 1840.
Brassavola scaposa Schltr. in Orchis 13:77. 1919.

Erect or pendent epiphytic herbs up to about 40 cm. long, usually less; flowers often showy. Stems or pseudobulbs 2–12 cm. long, cylindric, slender, 0.2–0.5 cm. in diameter, usually covered with a pergameneous sheath, 1-leaved. Leaves 6–23 cm. long and 0.3–2.5 cm. broad, either terete or flattened, if flattened then usually linear-elliptic, acute. Inflorescence borne at the end of the stem, either shorter or longer than the subtending leaf, few- to several-flowered. Sepals 4–9 cm. long and 0.2–0.4 cm. broad, linear, acute. Petals 4–9 cm. long, 0.05–0.2 cm. broad, filiform to linear, acute. Lip 4.5–8 cm. long and 2.5–4 cm. broad; base unguiculate and cucullate, enfolding the column; anterior portion broad, cordate to orbicular-cordate, acuminate or at least apiculate, having several prominent veins.

Fig. 140. *Brassavola nodosa*

Mexico to Panama, the West Indies and northern South America. Common at lower elevations in Central America.

BOCAS DEL TORO: Shepherd Hill, *Wedel 2;* vicinity of Chiriquí Lagoon, *Wedel 1413, 1995, 2644.* CANAL ZONE: vicinity of Fort Sherman, *Allen 2844;* France Field, *Powell 25;* between Tumba Vieja and Salamanca, *Steyermark & Allen 16753.* PANAMÁ: vicinity of La Palma, *Pittier 6689;* Trapiche Island, *Allen 2608;* Taboga Island, *Killip 3181;* Hacienda La Joya, *Dodge et al 16903;* Isla Taboga, *Woodson, Allen & Seibert 1487;* Cativo, *Lee s. n.* VERAGUAS: Cerro Pena de Cristo, alt. 1500 m., *Powell 422.*

2. BRASSAVOLA ACAULIS Lindl. in Paxt. Flow. Gard. 2:152, *fig. 216.* 1851-52.

Brassavola lineata Hook. in Bot. Mag. 79: *t. 4734.* 1853.

Pendent epiphytic herbs up to about 80 cm. long. Stems 2–7 cm. long, 0.2–0.5 cm. in diameter, cylindrical, unifoliate. Leaves 40–80 cm. long, 0.3–2 cm. in diameter, terete, fleshy. Inflorescence borne from the rhizome on short peduncles (stems?), 1-, rarely 2-, flowered, much shorter than the leaves. Sepals and petals 7–8 cm. long, 0.3–0.6 cm. broad, linear, acute. Lip 5.5–6.5 cm. long and 2.5–3.5 cm. broad; base unguiculate, cucullate, enfolding the column; anterior part orbicular to orbicular-cordate, acute or acuminate, prominently veined.

Panama, reported also from Costa Rica and Guatemala.

CHIRIQUÍ: "province of Chiriquí," alt. 1200 m., *Powell 102;* "Chiriquí province," *Svihla s. n.;* Boquete District, alt. 1200 m., *Davidson 683.*

32. SCAPHYGLOTTIS Poepp. & Endl.

SCAPHYGLOTTIS Poepp. & Endl. Nov. Gen. & Sp. 1:58. 1835.

Cladobium Lindl. Nat. Syst. Bot. 446. 1836 (or 1835?).
Hexadesmia Brongn. in Ann. Sci. Nat. Bot. II, 17:44. 1842.

Caespitose or repent epiphytic herbs. Stems indurated or pseudobulbose, simply branched, or fasciculately branched (superimposed) above. Leaves 1–3 from the apex of the segments of the stem or pseudobulbs, thin and grass-like to coriaceous or fleshy and terete. Inflorescence a fascicle or a raceme, terminal on the growths or segments of the stem. Sepals subequal, erect. Petals similar to the sepals but usually smaller. Lip articulated from the tip of the column-foot or subarticulated, straight, geniculate, reflexed or recurved, clawed or clawless, entire or 3-lobed, often emarginate. Column short, wingless or winged or auriculate, produced into a more or less distinct foot at the base; anther terminal, operculate, incumbent, the loculae provided with longitudinal septae; pollinia 4 or 6, if 6 then all of equal size or two smaller than the others, ceraceous, laterally compressed (at least 4 of each set compressed).

A difficult but interesting genus of some 40 or 50 species. The generic name *Scaphyglottis* should, in all probability, be substituted by *Cladobium* Lindl. The original generic description of *Scaphyglottis* obviously applies more to *Scaphyglottis parviflora* Poepp. & Endl. than to any of the other component species. Of the species described in the original publication most are *Maxillaria,* and the generic description applies best to those species which belong to the genus *Maxillaria.*

a. Inflorescence about as long as or longer than the subtending leaves........ 1. S. MICRANTHA
aa. Inflorescence much shorter than the subtending leaves, commonly less than half as long.
b. Lip with short, acute, dentiform lateral lobes originating about the middle of the lip........ 12. S. BILINEATA
bb. Lip without short, acute, dentiform lateral lobes.
c. Column provided with stelidiar arms or teeth near the apex or near the middle.
d. Stelidiar arms near the apex of the column.
e. Lip entire or at most obscurely trilobulate........ 5. S. LAEVILABIA
ee. Lip trilobate, the lateral lobes distinct........ 7. S. AMETHYSTINA
dd. Stelidiar arms near the middle of the column........ 9. S. MESOCOPIS
cc. Column lacking stelidiar arms or teeth near the apex or near the middle, sometimes auriculate.
d. Lip widest at the middle or toward the base.
e. Leaves about five times longer than broad, linear-elliptic to elliptic to oblanceolate........ 3. S. LINDENIANA
ee. Leaves at least ten times longer than broad, linear to linear-lanceolate.
f. Lip rhombic-lanceolate, broadest below the middle........ 11. S. TENELLA
ff. Lip obovate to oblong, broadest across the auriculate lobes near the middle........ 10. S. MINUTIFLORA
dd. Lip widest above the middle, usually near the apex.
e. Leaves relatively short and broad, mostly less than 6 cm. long........ 4. S. CUNEATA
ee. Leaves relatively long and narrow, grass-like, mostly more than 6 cm. long (if less, then only 1–2 mm. broad).
f. Lip 3-lobed and with the lobes about equal in length........ 6. S. LONGICAULIS
ff. Lip simple or obscurely 3-lobed, if lobed then the lateral lobes shorter than the mid-lobe.
g. Lip pandurate or subpandurate, terminal lobe broad, rounded and apiculate........ 2. S. ACOSTAEI
gg. Lip not pandurate nor subpandurate, terminal lobe retuse........ 8. S. BEHRII

1. SCAPHYGLOTTIS MICRANTHA (Lindl.) Ames & Correll in Bot. Mus. Leafl. Harv. Univ. 10:85. 1942.

Hexadesmia micrantha Lindl. in Bot. Reg. 30: Misc. 2. 1844; Reichb. f. Xenia Orch. 1:70, *t. 59, figs. III, 6–10.* 1856.

Small, caespitose, epiphytic herbs up to about 20 cm. tall. Stems pseudobulbose, fusiform, stipitate, simple or rarely superimposed, 1- or usually 2-leaved at the apex. Leaves 3–12 cm. long and 0.15–0.5 cm. broad, linear, obtuse, usually bilobed at the apex. Inflorescence a terminal, slender, few- to many-flowered raceme about as long as or exceeding the leaves in length; flowers small. Dorsal sepal about 1.5 mm. long and 0.75 mm. broad, oval, acute. Lateral sepals 1.5–2 mm. long and 1–1.5 mm. broad, ovate, acute. Petals 1.5–2 mm. long and about 1 mm. broad, oval or ovate, obtuse. Lip 1.2–2 mm. long and 1.5–2.5 mm. broad, subreniform, trilobate,—in natural position the lateral lobes erect and surrounding the column and the terminal lobe deflexed.

Guatemala, Salvador, Honduras, Nicaragua, Costa Rica and Panama.

"VERAGUAS and CHIRIQUÍ": *Warscewicz.*

The smallest-flowered species of the genus.

2. Scaphyglottis Acostaei (Schltr.) C. Schweinf. in Bot. Mus. Leafl. Harv. Univ. 10:27. 1941.

Hexadesmia Powellii Schltr. in Fedde Rep. Sp. Nov. Beih. 17:27. 1922, non *Scaphyglottis Powellii* Schltr.
Hexadesmia Acostaei Schltr. loc. cit. 19:293. 1923.

Small, slender, densely caespitose, epiphytic herbs up to 30 cm. tall. Pseudobulbs 2.5–12 cm. long and 0.1–0.6 cm. in diameter, the upper part swollen and fusiform, the lower part forming a slender stipe, 1- or usually 2-, leaved. Leaves 5–14 cm. long and 0.1–0.3 cm. broad, linear, obtuse, the apex usually bilobed. Inflorescence a short, terminal, few-flowered raceme, much exceeded by the leaves. Flowers small, usually white with a dark lip. Sepals 3–4 mm. long and 1.4–1.8 mm. broad, lanceolate to ovate-lanceolate, acuminate. Petals 3–4 mm. long and 1.4–2 mm. broad, lanceolate or lanceolate-oblong, acute. Lip 3–4 mm. long and 2.5–4 mm. broad, oblong or oblong-subquadrate, pandurate, acute or retuse and apiculate.

Costa Rica and Panama.

chiriquí: Volcán de Chiriquí, alt. 2100 m., *Davidson 867;* slope of Cerro de la Horqueta, alt. 1200–1700 m., *Maxon 5399;* alt. 1500 m., *Powell 225.*

3. Scaphyglottis Lindeniana (Rich. & Gal.) L. Wms. in Ann. Missouri Bot. Gard. 28:423. 1941.

Hexadesmia fasciculata Brongn. in Ann. Sci. Nat. Bot. II, 17:45. 1842, non *Scaphyglottis fasciculata* Hook.
Hexadesmia Lindeniana Rich. & Gal. in Ann. Sci. Nat. Bot. III, 3:23. 1845.
Hexadesmia pachybulbon Schltr. in Fedde Rep. Sp. Nov. Beih. 17:26. 1922.

Small to large and coarse epiphytic herbs up to about 50 cm. tall. Stems usually stipitate below, swollen into an ellipsoidal or fusiform pseudobulb above, bifoliate. Leaves 5–25 cm. long and 1.5–5 cm. broad, linear-elliptic to elliptic to lanceolate to oblanceolate, acute, coriaceous. Inflorescence a fascicle of flowers borne at the apex of the pseudobulb. Dorsal sepal 7–11 mm. long and 1.5–2 mm. broad, elliptic, acute. Lateral sepals 7–11 mm. long and 2–3 mm. broad, lanceolate, arcuate, acute. Petals 6–10 mm. long and 1.5–3 mm. broad, elliptic-lanceolate, acute. Lip 6.5–10 mm. long and 2.5–4.5 mm. broad, oblanceolate to narrowly obovate, obscurely 3-lobed, obtuse, apiculate.

Mexico, Guatemala, Costa Rica and Panama.

chiriquí: "Province of Chiriquí," alt. 1500 m., *Powell 229, 3149.* coclé: hills north of El Valle de Antón, alt. 800–1000 m., *Allen 2291;* mountains beyond La Pintada, alt. 400–600 m., *Hunter & Allen 601.*

Scaphyglottis falcata C. Schweinf. is possibly only a somewhat larger-flowered form of this variable species.

4. Scaphyglottis cuneata Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:398. 1918.

Scaphyglottis prolifera (R. Br.) Cogn. and other authors as to plants, not according to name-bringing synonym.
Tetragamestus gracilis Schltr. loc. cit. 400.

Scaphyglottis Wercklei Schltr. in Fedde Rep. Sp. Nov. Beih. 19:28. 1923.
Scaphyglottis gracilis Schltr. loc. cit.
Isochilus prolifera Lindl. ex C. Schweinf. in Bot. Mus. Leafl. Harv. Univ. 11:181. 1944, non R. Br.

Small, caespitose or repent, epiphytic herbs up to about 25 cm. long. Stems pseudobulbose, usually superimposed; pseudobulbs slender and cylindric to narrowly fusiform, usually bifoliate at the top of each segment of the growth. Leaves 1–6 cm. long and 0.1–0.7 cm. broad, linear or ligulate to elliptic-oblong, obtuse, usually retuse. Inflorescence a single flower or a few-flowered fascicle borne at the apex of the segments of the stem. Dorsal sepal 3.5–4.5 mm. long and 1.2–1.5 mm. broad, elliptic to elliptic-oval, acute, cucullate. Lateral sepals 4–5 mm. long and 1.5–2.5 mm. broad, linear-oblong, oblique, acute, forming an inconspicuous mentum at the base. Petals 3.5–5 mm. long and 0.5–0.6 mm. broad, linear to linear-ligulate, obtuse or acute, slightly oblique. Lip 4–6 mm. long and 2.5–4 mm. broad toward the apex, unguiculate, cuneate-flabellate, the apical part semi-orbicular, obtuse, entire or trilobate; disc with a small flabellate or bipartite callus toward the apex of the claw or rarely ecallous. Column without stelidiar arms.

Guatemala, British Honduras, Honduras, Nicaragua, Costa Rica and Panama, the West Indies and in South America to Brazil and Bolivia.

CANAL ZONE: near Río Medio, *Miller 1747;* San Juan Range, *Powell 349;* hills north of Frijoles, *Standley 27668.* COCLÉ: vicinity of El Valle de Antón, alt. 600–1000 m., *Allen 1248.*

5. SCAPHYGLOTTIS LAEVILABIA Ames in Proc. Biol. Soc. Wash. 34:154. 1921, as *S. laevilabium.*

Similar to *Scaphyglottis cuneata* except the disc of the lip always ecallous and the column with two small stelidiar arms about opposite the stigmatic cavity.

Panama.

PANAMÁ: Juan Díaz, alt. 50 m., *Killip 3113;* foothills east of Panamá City, *Powell 211.*

6. SCAPHYGLOTTIS LONGICAULIS S. Wats. in Proc. Am. Acad. 23:286. 1888.
Scaphyglottis unguiculata Schltr. in Fedde Rep. Sp. Nov. 12:206. 1913.

Slender, caespitose, epiphytic herbs up to about 30 cm. tall. Stems slender, the pseudobulbs cylindric, simple or rarely superimposed, bearing 1 or 2 leaves at the summit of the segments. Leaves 4–16 cm. long and 0.1–0.3 cm. broad, linear. Inflorescence one-flowered, or a few-flowered fascicle at the apex of the stem or of segments of the stem. Dorsal sepal 5–7 mm. long and about 1.5 mm. broad, linear-oblong to linear-oblanceolate, acute, somewhat cucullate. Lateral sepals 5.5–7 mm. long and 1.5–2 mm. broad, linear-oblong, acute, forming a distinct mentum at the base. Petals 5–7 mm. long and about 0.7–1 mm. broad, linear-oblanceolate, obtuse or acute. Lip 5–7 mm. long and 3–4 mm. broad near the apex, unguiculate, cuneate-flabellate, trilobate at the apex; disc ecallous. Column sometimes with lateral teeth at the apex.

Guatemala, Honduras, Costa Rica, Panama and Colombia.

CANAL ZONE: Barro Colorado Island, *Kenoyer 251;* hills east of Panamá City, *Powell 105, 3392;* hills north of Frijoles, *Standley 27664;* Río Indio, *Steyermark & Allen 17442.* COLÓN: Loma de la Gloria, *Pittier 4090.* DARIÉN: vicinity of El Real, alt. 15 m., *Allen 944.*

7. SCAPHYGLOTTIS AMETHYSTINA (Reichb. f.) Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:456. 1918.

Ponera amethystina Reichb. f. in Saunders Ref. Bot. 2: *t. 93.* 1869.
Scaphyglottis brachiata Schltr. in Fedde Rep. Sp. Nov. 9:432. 1911.

Caespitose epiphytic herbs up to about 25 cm. tall. Stems simple or superimposed, segments cylindric to fusiform, often distinctly stipitate, bearing 1 or usually 2 leaves at the apex of each segment. Leaves 3–12 cm. long and 0.4–1 cm. broad, linear, linear-lanceolate to elliptic, obtuse, the apex retuse and unequally bilobed. Inflorescence a few-flowered fascicle borne at the apex of the segments. Dorsal sepal 4.5–6 mm. long and about 1.5 mm. broad, elliptic to oblanceolate, acute, cucullate. Lateral sepals 5–7.5 mm. long and 1.5–2 mm. broad, linear-oblong to lanceolate, acute, forming a short mentum at the base. Petals 4.5–5 mm. long and 0.8–1.2 mm. broad, linear-oblong and unguiculate to oblanceolate, acute. Lip 6–8 mm. long and 3–5 mm. broad, cuneate, obovate, 3-lobed, the lateral lobes large, rounded, situated above the middle of the lip; mid-lobe subquadrate, obtuse, rarely emarginate, exceeding the lateral lobes. Column with 2 stelidiar arms near the apex.

Costa Rica and Panama.

CANAL ZONE: Chagres River, sea-level, *Powell 358.* CHIRIQUÍ: vicinity of San Felix, alt. 0–120 m., *Pittier 5193.*

8. SCAPHYGLOTTIS BEHRII (Reichb. f.) Benth. & Hook. ex Hemsl. in Godm. & Salvin, Biol. Centr.-Am. Bot. 3:219. 1883; C. Schweinf. in Bot. Mus. Leafl. Harv. Univ. 7:186. 1939.

Ponera Behrii Reichb. f. in Bonplandia 3:220. 1855.
Ponera albida Reichb. f. in Beitr. Orch. Centr.-Am. 103. 1866.
Scaphyglottis pauciflora Schltr. in Fedde Rep. Sp. Nov. 3:47. 1906.
Scaphyglottis albida Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:456. 1918.

Caespitose, epiphytic or pendent herbs up to about 45 cm. long. Stems simple or superimposed; segments cylindric to narrowly elliptic or narrowly fusiform, 1-leaved or usually 2-leaved at the apex, at least the lower segment stipitate. Leaves 5–26 cm. long and 0.15–0.45 cm. broad, linear, obtuse, obscurely bilobed at the apex. Inflorescence a single flower or a few-flowered fascicle or one or more much abbreviated few-flowered racemes borne at the apex of the segments of the stem. Dorsal sepal 3–4 mm. long and 1–1.5 mm. broad, elliptic-oblong to elliptic-oval, obtuse, cucullate. Lateral sepals 3.5–4.5 mm. long and 1.2–2 mm. broad, linear-oblong to oblong, acute. Petals 3–4 mm. long and 0.5–1 mm. broad, linear to linear-lanceolate, obtuse, more or less unguiculate. Lip 3.5–5 mm. long and 2–3.5 mm. broad, narrowly obovate, unguiculate, entire to obscurely 3-lobed, obtuse and rarely shallowly retuse. Column with a narrow wing.

Guatemala, British Honduras, Honduras, Nicaragua, Costa Rica, Panama and Colombia.

CANAL ZONE: Chagres, *Behr;* near Gatún, *Hayes;* hills east of Panamá City, Juan Díaz Range, San Juan Range, La Pita, McComber Hill, Frijoles, Juan Díaz, *Powell 126, 359, 363, 367, 369, 373, 374, 378, 3506;* Barro Colorado Island, *Woodworth & Vestal 592.* CHIRIQUÍ: Lino Hill, *Powell 385.* PANAMÁ: Río Tecúmen, *Hunter & Allen 229.* VERAGUAS: Bahia Honda, *Taylor 1507.*

It is possible that the historical type of *Scaphyglottis Behrii* is not the species commonly interpreted as such. We have not seen the original specimen collected by Behr. A record from the Reichenbach herbarium (not from the type) does not match too well.

9. SCAPHYGLOTTIS MESOCOPIS (Endr. & Reichb. f.) Benth. & Hook. ex Hemsl. in Biol. Centr.-Am. Bot. 3:220. 1883.

Ponera mesocopis Endres & Reichb. f. Xenia Orch. 2:222, *t. 200.* 1874.
Scaphyglottis Powellii Schltr. in Fedde Rep. Sp. Nov. Beih. 17:28. 1922.

Caespitose, erect or repent, epiphytic herbs up to about 50 cm. long. Stems pseudobulbose, cylindric or usually fusiform, commonly stipitate; segments superimposed, 1- to 2-leaved at the apex, the lower segment often bearing a fascicle of stems at its apex. Leaves 3–17 cm. long and 0.2–0.7 cm. broad, linear, obtuse, usually bilobate at the apex. Inflorescence a few-flowered fascicle or a much-abbreviated raceme borne at the apex of the segments of the stem. Dorsal sepal 5.5–7 mm. long and 1.8–2.5 mm. broad, elliptic to elliptic-oblong, acute. Lateral sepals 6–8 mm. long and 1.8–2.5 mm. broad, linear-oblong to lanceolate-oblong, acute or obtuse, slightly arcuate, forming a short mentum at the base. Petals 5–7 mm. long and 1.4–2 mm. broad, linear-oblong to elliptic-lanceolate, acute or obtuse, short-unguiculate. Lip 7–10 mm. long and 3.5–4.5 mm. broad, oblong-subpandurate, usually broadest near the apex, cuneate to the base and short-unguiculate, obtuse and emarginate, obscurely denticulate; disc with one or more of the median lines raised and papillose. Column with two stelidiar arms originating at about the middle.

Costa Rica and Panama.

CANAL ZONE: hills east of Panamá City, *Powell 134.* CHIRIQUÍ: vicinity of Boquete, near Río Caldera, alt. 1300 m., *Allen 2282;* Boquete, alt. 1200 m., *Davidson 1283;* "Province of Chiriquí," alt. 1000 m., *Powell 134.* COCLÉ: vicinity of La Mesa north of El Valle de Antón, alt. 1000 m., *Allen 2316;* region north of El Valle de Antón, alt. 800 m., *Allen 2926.*

The Powell record for the Canal Zone is doubtless in error, for the same number is used for the specimen from Chiriquí.

10. SCAPHYGLOTTIS MINUTIFLORA Ames & Correll in Bot. Mus. Leafl. Harv. Univ. 10:83, *t. 9.* 1942.

Caespitose epiphytic herbs up to about 75 cm. tall. Stems slender, cylindric to slightly fusiform, superimposed, 1- to 2-leaved from the apex of the segments. Leaves 5–18 cm. long and 0.3–1 cm. broad, linear, acute or obtuse, retuse and unequally bilobed at the apex. Inflorescence a few-flowered fascicle, borne at the apex of segments of the stem. Dorsal sepal about 2.4 mm. long and 1.3 mm.

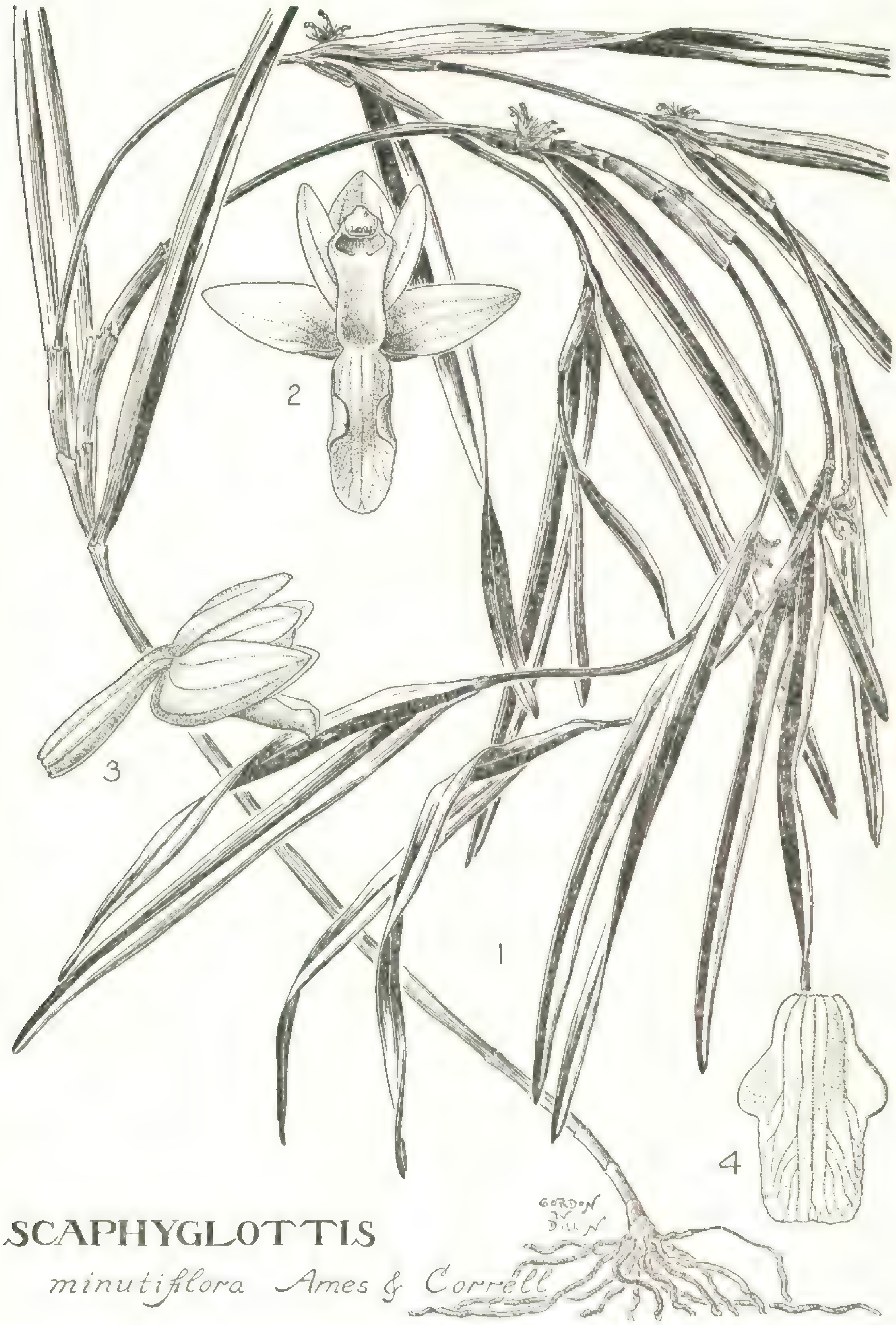

Fig. 141. *Scaphyglottis minutiflora*

broad, oval, acute. Lateral sepals about 2.5 mm. long and 1.4 mm. broad, elliptic-oblong, acute, forming an inconspicuous mentum at the base. Petals about 2.2 mm. long and 0.6 mm. broad, narrowly elliptic-oblong, acute or obtuse. Lip 2.5–4 mm. long and 1.5–2.5 mm. broad, obovate to oblong, obtuse or obscurely retuse, provided with small, semi-orbicular, auriculate lobes near the middle.

Guatemala, British Honduras and Panama.

COCLÉ: hills north of El Valle de Antón, alt. 800–1000 m., *Allen 2258*.

It is possible that the Panamanian material is different from the Guatemalan type.

11. SCAPHYGLOTTIS TENELLA L. Wms. in Ann. Missouri Bot. Gard. 28:423, *t. 24*. 1941.

Caespitose, erect or spreading, epiphytic herbs up to about 50 cm. long. Stems slender, cylindric or becoming swollen and fusiform above, simple, bifoliate at the apex. Leaves 20–23 cm. long and 0.7–1.6 cm. broad, linear to linear-lanceolate, acute, the apex minutely bilobed. Inflorescence a 1- to few-flowered fascicle at the apex of the stem. Dorsal sepal 8–9 mm. long and 3–4 mm. broad, lanceolate, acute. Lateral sepals 8–9 mm. long and 3–4 mm. broad, lanceolate, acute. Petals 8–9 mm. long and 3–3.5 mm. broad, oblong-lanceolate, acute or obtuse. Lip 8–9 mm. long and 4–5 mm. broad, rhombic-lanceolate but somewhat constricted above the middle, fleshy.

Panama.

COCLÉ: hills north of El Valle de Antón, alt. 800–1000 m., *Allen 2276*.

12. SCAPHYGLOTTIS BILINEATA (Reichb. f.) Schltr. in Beih. Bot. Centralbl. 36, Abt. 2:456. 1918.

Ponera bilineata Reichb. f. Beitr. Orch. Centr.-Am. 88. 1866.

Erect or spreading, caespitose, epiphytic herbs up to about 30 cm. long. Stems slender, simple or superimposed, cylindric, 1- to 2-foliate at the apex of the segments. Leaves 6–9 cm. long and 0.7–1.1 cm. broad, ligulate to linear-lanceolate, obtuse. Inflorescence a 1- to few-flowered fascicle borne at the apex of the segments. Dorsal sepal about 7 mm. long and 2 mm. broad, elliptic or oblanceolate, obtuse. Lateral sepals about 8 mm. long and 2.5 mm. broad, lanceolate-oblong, slightly arcuate, acute. Petals about 7 mm. long and 0.8 mm. broad, linear, obtuse. Lip about 9 mm. long and 3.5 mm. broad, cuneate-unguiculate to the base, 3-lobed; the lateral lobes originating above the middle, dentiform; the mid-lobe suborbicular-flabellate, slightly retuse; disc fleshy, especially the basal portion, with the median line callus-thickened toward the apex. Column auriculate at the apex.

Costa Rica and Panama.

CANAL ZONE: Quebrada Lopez, alt. 30 m., *Allen 2139*. COCLÉ: hills north of El Valle de Antón, alt. 800–1000 m., *Allen 2263*.

May be expected to be more variable than the description indicates.

Fig. 142. *Scaphyglottis tenella*

OBSCURE SPECIES

SCAPHYGLOTTIS DOLICHOPHYLLA Schltr. in Fedde Rep. Sp. Nov. Beih. 17:28. 1922.

Panama.

This species is based on *Powell 126* of which I have seen two specimens. One of these is *Scaphyglottis Behrii,* while the other is very similar but recalls in some respects Schlechter's analysis of S. *dolichophylla.*

33. PLATYGLOTTIS L. Wms.

PLATYGLOTTIS L. Wms. in Ann. Missouri Bot. Gard. 29:345, *t. 34.* 1942.

Caespitose, epiphytic herbs from a very short rhizome. Stems slender, non-pseudobulbose, indurated, simple. Leaves alternate, distichous, coriaceous, plane, deciduous; leaf-sheaths tightly enfolding the stem. Inflorescence terminal (or subterminal?), racemose. Sepals subequal; dorsal sepal free; lateral sepals adnate to the short column-foot at their bases and with it forming an inconspicuous mentum. Petals similar to the sepals or broader. Lip articulated to the apex of the column-foot; lamina broadly ligulate, entire. Column short, clavellate, wingless, produced into a short foot at the base; anther terminal, operculate, incumbent, 6-loculate; pollinia 6, equal, 4 basal and laterally compressed in one series, 2 terminal in a second laterally compressed series, ceraceous.

A single species known only from the vicinity of El Valle de Antón, Coclé Province, Panama.

1. PLATYGLOTTIS CORIACEA L. Wms. in Ann. Missouri Bot. Gard. 29:347, *t. 34.* 1942.

Epiphytic, caespitose herbs up to about 4.5 dm. tall. Stems 5–8 mm. in diameter, slender, leafy, becoming naked with age. Leaves 2.5–6 cm. long, 1–1.5 cm. broad, narrowly ligulate, obtuse, obscurely and unequally bilobed at the apex, coriaceous, distichous. Inflorescence a short, few-flowered raceme, terminal or subterminal; bracts 7–20 mm. long, elliptic-lanceolate, acute, cucullate; flowers rather large for the tribe, sepals and petals lavender, the lip lavender with greenish margins. Dorsal sepal about 10 mm. long and 3.5 mm. broad, lanceolate, acute or acuminate, 5-nerved. Lateral sepals about 10 mm. long and 3 mm. broad, lanceolate, acute or acuminate, slightly oblique, 5-nerved. Petals about 10 mm. long and 3.5 mm. broad, elliptic-oblanceolate, somewhat oblique, obscurely constricted near the apex, 5- to 7-nerved. Lip about 10 mm. long and 5 mm. broad toward the apex, broadly ligulate, subpandurate, entire, apex rounded, the margins thin and plicated laterally; disc fleshy, with a pair of inconspicuous, subumbonate calluses at the base.

Panama.

COCLÉ: north of El Valle de Antón, alt. about 1000 m., *Allen 2936.*

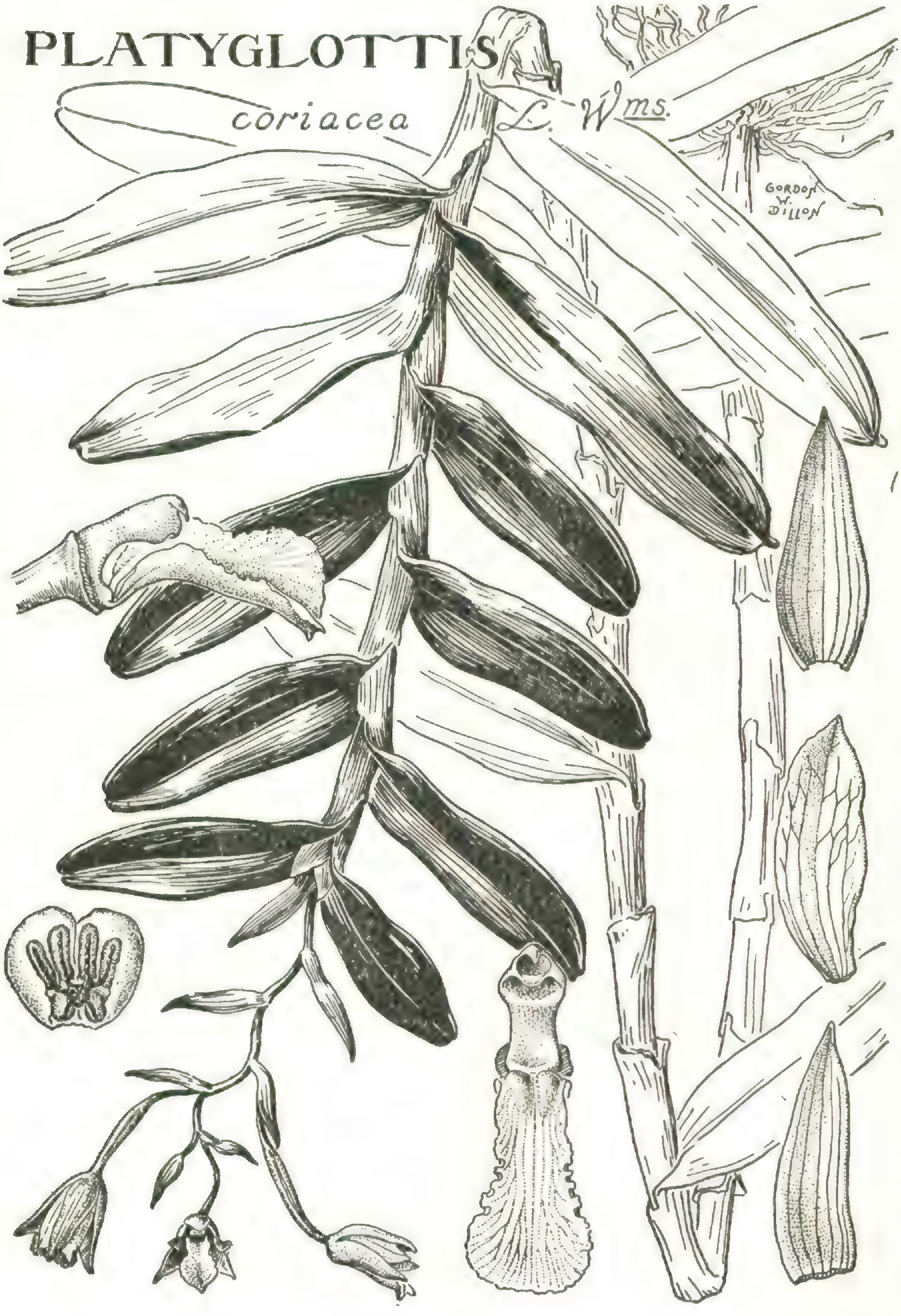

Fig. 143. *Scaphyglottis coriacea*

34. ISOCHILUS R. Br.

Isochilus R. Br. in Ait. Hort. Kew. ed. 2, 5:209. 1813; Correll in Bot. Mus. Leafl. Harv. Univ. 10:1. 1941.

Caespitose, epiphytic herbs with slender stems and distichous leaves. Inflorescence a terminal, often unilateral raceme. Sepals subequal, free or connate into a short tube at the base, sometimes more or less subsaccate at the base. Petals about as long as the sepals. Lip subequal to the petals, simple, adnate to the base of the column or column-foot, often semiterete, wingless; column-foot very short and inconspicuous; pollinia 4, ceraceous, elongated and laterally compressed.

Closely allied to *Ponera* and *Jacquiniella*. According to Correll, the genus consists of two species, both variable.

1. Isochilus major Cham. & Schlecht. in Linnaea 6:60. 1831; Correll in Bot. Mus. Leafl. Harv. Univ. 10:9. 1941.

Isochilus chiriquensis Schltr. in Fedde Rep. Sp. Nov. Beih. 17:25. 1922.

Caespitose, erect or spreading, slender, epiphytic herbs. Stems simple, slender, leafy. Leaves 2–10 cm. long and 0.2–0.8 cm. broad, linear to linear-elliptic, obtuse, emarginate and unequally bilobed at the apex. Inflorescence secund, usually several- to many-flowered; flowers subtended by conspicuous chartaceous bracts. Dorsal sepal 7–11 mm. long and 3–4 mm. broad, elliptic-oblong, acute or obtuse. Lateral sepals 8–12 mm. long and 3–4.5 mm. broad, oblong-lanceolate, acute, keeled toward the base, and the keel decurrent onto the ovary. Petals 7–11 mm. long and 2–3 mm. broad, oblanceolate, acute or obtuse. Lip 8–12 mm. long and 1.5–3 mm. broad, elliptic-linear to

Fig. 144. *Isochilus major*

linear-oblong to oblanceolate, acute or obtuse, entire or obscurely lobed, geniculate and fleshy at the base.

Mexico, Guatemala, Honduras, Costa Rica, Panama and Jamaica.

CHIRIQUÍ: Río Quebrada, alt. 1700 m., *Killip 3532;* "Province of Chiriquí," alt. 1200 m., *Powell 98, 3380;* Bajo Mona, alt. 1500–2000 m., *Woodson, Allen & Seibert 1003;* vicinity of Bajo Mona, alt. 1500 m., *Woodson & Schery 518.*

Fig. 145
Bothriochilus macrostachyus

35. BOTHRIOCHILUS[1] Lemaire

BOTHRIOCHILUS Lemaire, Illustr. Hort. 3:Misc. p. 31. 1856; L. Wms. in Bot. Mus. Leafl. Harv. Univ. 8:145. 1940.

Epiphytic herbs with the stems reduced to ovoid or lageniform pseudobulbs. Pseudobulbs several-leaved at their apices, the petioles of the leaves simulating stems. Inflorescence lateral from the base of the pseudobulbs. Dorsal sepal free. Lateral sepals adnate to the column-foot and with it forming a mentum. Petals similar to the dorsal sepal but usually shorter. Lip simple or obscurely lobed, about as long as the petals, shortly and sharply declined at the base or even saccate, if saccate the sac sometimes didymous. Column erect, long and slender, wingless or nearly so; column-foot about as long as the column or longer; pollinia 8, ceraceous. Ovary wingless.

A single species is known from Panama.

1. BOTHRIOCHILUS MACROSTACHYUS (Lindl.) L. Wms. in Bot. Mus. Leafl. Harv. Univ. 8:148. 1940.

Coelia macrostachya Lindl. in Benth. Pl. Hartw. 92. 1842; Hook. in Bot. Mag. 79: *t. 4712.* 1853; Reichb. f. Beitr. Orch. Centr.-Am. 41. 1866.

[1] To this genus belong all of the species previously referred to *Coelia,* except the type species.

Coelia macrostachya Lindl. var. *genuina* Reichb. f. loc. cit.
Coelia macrostachya Lindl. var. *integrilabia* Reichb. f. loc. cit.

Epiphytic herbs up to about 90 cm. tall. Pseudobulbs up to about 8 cm. long, ovoid to semi-globose, often somewhat compressed, surrounded with scarious sheaths at the base, bearing 3–6 leaves at the summit. Leaves 30–100 cm. long and 0.8–2.5 cm. broad, linear to elliptic-ligulate, acute or acuminate, plicate, sheathing at the base. Inflorescence a densely flowered, more or less elongated raceme, lateral, up to about 50 cm. long, the scape somewhat flexuous, covered with chartaceous bracts; the rachis provided with conspicuous linear to lanceolate, acute or acuminate bracts up to about 7 cm. long. Dorsal sepal 7.5–11 mm. long and 3–5 mm. broad, elliptic-ovate to ovate, acute, rugose dorsally. Lateral sepals 10–14 mm. long and 4–5 mm. broad, oblong-lanceolate, acute, free but forming a short obtuse mentum, rugose dorsally. Petals 7–11 mm. long and 3–5 mm. broad, elliptic-ovate to rhombic-obovate, acute. Lip 11–14 mm. long and 4–6 mm. broad, oblong-pandurate, angled or dentate-lobed above the middle, terminal part of the lip reflexed, lanceolate, base of lip forming a shallow didymous spur.

Mexico, Guatemala, Honduras and Panama.

CHIRIQUÍ: "Chiriquí Cordilleren," alt. 1800 m., *Warscewicz*.

The Panamanian record is a specimen cited by Reichenbach.

36. POLYSTACHYA Hook.

POLYSTACHYA Hook. Exot. Fl. 2: *t. 103*. 1825; Kränzlin in Fedde Rep. Sp. Nov. Beih. 39:1–136. 1926.

Epiphytic or rarely terrestrial, caespitose, pseudobulbose (Panamanian species) herbs. Inflorescence a raceme or panicle. Dorsal sepal free. Lateral sepals larger than the dorsal, forming a mentum at their bases. Petals much smaller than the sepals, usually linear. Lip non-resupinate, nearly entire or usually 3-lobed; disc of the lip usually with a conspicuous callus and often covered with fragile, articulated or farinaceous cells. Column short, with a prominent foot; pollinia 4, or 4 joined into 2.

Kränzlin, in his monograph, lists 188 species of *Polystachya*, mostly African.

a. Ovary and rachis of the inflorescence glabrous .... 1. P. CEREA
aa. Ovary and rachis of the inflorescence pubescent .... 2. P. MASAYENSIS

1. POLYSTACHYA CEREA Lindl. in Bot. Reg. 26: Misc. p. 86. 1840.

Polystachya minor Fawc. & Rendle in Jour. Bot. 48:106. 1910.
Polystachya panamensis Schltr. in Fedde Rep. Sp. Nov. Beih. 17:49. 1922.
Polystachya costaricensis Schltr. loc. cit. 19:223. 1923.
Polystachya Powellii Ames, Sched. Orch. 7:31. 1924.

Caespitose, epiphytic herbs up to about 60 cm. tall, commonly 10–15 cm. tall. Stems very short, pseudobulbose; pseudobulbs ovoid to fusiform or cylindric, usually enclosed in bracts or the leaf-sheaths, bearing 2–5 leaves. Leaves 3–26

cm. long and 0.4–3 cm. broad, variable, linear to oblong-elliptic to oblanceolate, acute or obtuse, the sheaths enclosing the peduncle at the base. Inflorescence terminal, the peduncle covered with scarious sheaths, bearing a single terminal raceme or 1 or more short lateral racemes from the nodes of the peduncle. Dorsal sepal 3–3.5 mm. long and 1.6–2 mm. broad, lanceolate, ovate to oblong-ovate, acute. Lateral sepals 3–4.5 mm. long and 1.5–3 mm. broad, lanceolate-ovate to broadly ovate, acute or acuminate. Petals 2–2.5 mm. long and 0.5–1 mm. broad, obtuse or acute, slightly arcuate. Lip 2.5–3.5 mm. long and 2–3 mm. broad, oblong or oblong-ovate, 3-lobed; lateral lobes small, usually rounded, erect; mid-lobe large, truncate, apiculate or usually retuse; disc provided with an umbonate or mammillate callus at the base and with the terminal part covered with evanescent, farinaceous pubescence. Ovary glabrous.

Mexico, Central America, the West Indies, tropical South America.

CANAL ZONE: hills east of Panamá City, *Powell 122, 3426;* Barro Colorado Island, *Shattuck 228.* CHIRIQUÍ: opposite Lino, alt. 1200 m., *Powell 343.* COCLÉ: vicinity of El Valle, alt. 600–1000 m., *Allen 781, 1171.* PANAMÁ: Haicenda La Joya, alt. 50–300 m., *Dodge et al 16909;* Sabanas near Chepo, alt. 30 m., *Hunter & Allen 28.* PROVINCE NOT GIVEN: "hills," *Powell 122, 3439;* between Fort Clayton and Corozal, *Standley 29100.*

2. POLYSTACHYA MASAYENSIS Reichb. f. in Bonplandia 3:217. 1855.

Similar to *Polystachya cerea* Lindl. but usually somewhat smaller in size, vegetatively, and with the rachis of the inflorescence and the ovary downy-pubescent.

Mexico, Nicaragua, Costa Rica and Panama.

CANAL ZONE: Chagres, *Fendler 334.* COCLÉ: hills north of El Valle de Antón, alt. 1000 m., *Allen 2319;* Río Antón, alt. 500 m., *Hunter & Allen 380.* COLÓN: Cativa-Porto Bello trail, alt. sea-level, *Powell 366.*

Perhaps best treated as a mere variety of *P. cerea* Lindl.

37. GALEANDRA Lindl.

GALEANDRA Lindl. in Lindl. & Bauer, Illustr. Orch. Pl., Gen. *t. 8.* 1832.

Terrestrial or epiphytic herbs. Stems leafy, becoming thickened and pseudobulbose. Leaves distichous, plicate. Sepals free, equal, spreading. Petals similar to the sepals, sometimes broader. Lip entire or bilobed, adnate to the base of the column, with a conspicuous spur at the base; lateral lobes usually erect and enfolded over the column. Column erect, short; anther terminal, operculate, incumbent, imperfectly 2-celled; pollinia 4, ceraceous, often in pairs.

There are 3 species of *Galeandra* in Mexico and Central America, 2 of which occur in Panama—About 20 species in South America.

a. Plants epiphytic; lip large, with spur 4–5 cm. long .... 1. G. BAUERI
aa. Plants terrestrial; lip about 2 cm. long .... 2. G. JUNCEA

1. GALEANDRA BAUERI Lindl. in Lindl. & Bauer, Illustr. Orch. Pl., Gen. *t. 8.* 1832; Batem. Orch. Mex. & Guat. *t. 19.* 1840; Lindl. in Bot. Reg. 26: *t. 49.* 1840; L. Wms. in Ann. Missouri Bot. Gard. 26:284. 1939.

Galeandra Batemanii Rolfe in Gard. Chron. III, 12:431. 1892.

Fig. 146. *Polystachya masayensis*

Fig. 147. *Galeandra Baueri*

Caespitose, epiphytic herbs up to about 50 cm. tall. Stems pseudobulbose, fusiform to ovoid, covered with the leaf-sheaths or becoming naked, bearing up to about 8 leaves. Leaves 8–26 cm. long and 0.8–2 cm. broad, linear-elliptic to elliptic, acute or acuminate, plicate. Inflorescence a terminal few-flowered raceme; flowers relatively large and pretty. Dorsal sepal 15–19 mm. long and 3–5 mm. broad, oblanceolate, acute. Lateral sepals 16–20 mm. long and 4–6 mm. broad, lanceolate or elliptic-lanceolate, acute, slightly arcuate. Petals 16–20 mm. long and 4–6 mm. broad, elliptic to elliptic-oblanceolate, acute. Lip, including the spur, 40–50 mm. long and 30–40 mm. broad, infundibuliform, spur just about equalling the lamina in length; lamina suborbicular-rhombic, emarginate.

Mexico, British Honduras, Guatemala, Honduras, Panama and French Guiana. A variety in Peru.

BOCAS DEL TORO: in swamp near Almirante, *Nash 1962;* Shepherd Island, vicinity of Chiriquí Lagoon, *Wedel 2712.*

2. GALEANDRA JUNCEA Lindl. Sert. Orch. sub. *t. 37.* 1840; Cogn. in Mart. Fl. Bras. 3^4:306. 1895.

Strict terrestrial herbs up to about 50 cm. tall. Stems pseudobulbose, the pseudobulbs 1.5–2 cm. long, borne on the surface or just under the surface of the ground, simple, invested by the leaf-sheaths. Leaves up to about 20 cm. long and 0.5 cm. broad, ensiform, conduplicate. Inflorescence a simple (or branched?) few-flowered raceme. Sepals about 13 mm. long and 3.5–4 mm. broad, lanceolate, acute. Petals about 12 mm. long and 3.5 mm. broad, oblanceolate, acute. Lip 17–20 mm. long and about 16 mm. broad, obscurely trilobate, spurred; lamina when expanded broadly ovate in outline, with 2 small lamellate, pubescent calluses near the middle, and toward the apex a dense patch of pilose pubescence arranged in three lines; spur short, about 5 mm. long, directed outward and backward.

Panama, Venezuela, the Guianas and Brazil.

PANAMÁ: Isla Taboga, alt. 0–350 m., *Allen 1268;* Taboga Island, *Cheeseman 483.*

The description is drawn from the Panamanian material cited.

38. EPIDANTHUS L. Wms.

EPIDANTHUS L. Wms. in Bot. Mus. Leafl. Harv. Univ. 8:148. 1940.

Small, simple or branched, epiphytic herbs with slender, leafy, repent or caespitose stems lacking pseudobulbs. Leaves distichous, jointed at the base, plane or terete, linear or subfiliform; leaf-sheaths persistent on the stem. Inflorescence a terminal, distichous, fractiflex raceme. Sepals similar, free, reflexed or spreading. Petals narrower than the sepals, with a callus at the base. Lip simple or 3-lobed, adnate to the base of the column. Column short, terete, adnate to the lip or callus of the lip for its entire length; anther terminal, incumbent; pollinia 2, ceraceous.

A small Mexican and Central American genus of three species, only one of

which is known from Panama. It has been confused with *Epidendrum*, with which it has little affinity.

1. Epidanthus paranthicus (Reichb. f.) L. Wms. in Bot. Mus. Leafl. Harv. Univ. 8:150. 1940.

Epidendrum paranthicum Reichb. f. in Bot. Zeit. 10:732. 1852.
Epidendrum Sancti Ramoni Kränzl. in Vierteljahrschr. Naturforsch. Zürich 74:137. 1929.

Small, caespitose, epiphytic herbs up to 30 cm. tall. Stems slender, slightly fractiflex. Leaves 0.8–2.5 cm. long and 0.05–0.2 cm. broad, linear, semi-terete, obtuse, deciduous. Inflorescence a terminal, fractiflex, few- to several-flowered raceme; flowers small, white or yellow. Sepals similar, 2–3 mm. long and 1–1.5 mm. broad, lanceolate to ovate-lanceolate, acute, the laterals often slightly cucullate. Petals 2–2.5 cm. long and about 0.5 mm. broad, linear-lanceolate, acute. Lip 2.2–3 mm. long and 2–2.5 mm. broad, unguiculate; the claw adnate to the column; lamina cordate-orbicular to reniform, long-apiculate.

Mexico, Guatemala, Honduras, Costa Rica and Panama.

chiriquí: Bajo Chorro, Boquete District, alt. 1800 m., *Davidson 121*.

(To be continued in Part III, Fascicle 4)

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[1] For Woodson and Schery's "Flora of Panama" only the plant families and new entities are included in the ANNALS Index, since a complete Index will be appended at the end of each volume of the "Flora."

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